COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES

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DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled "**COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES"** submitted towards partial fulfillment of the requirements for the award of **MD in Anaesthesiology** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Mirley Rupinder Singh**, Professor, Department of Anaesthesiology, **Dr. Udeyana Singh**, Associate Professor, Department of Anaesthesiology and **Dr. Rajnish Garg**, Professor & Head, Department of Orthopaedics. No part of this thesis has formed the basis for the award of any degree previously.

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Dedicated

to

my family

&

Teachers

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Onwards and upwards!

Dr. Tanusha Saini

LIST OF ABBREVIATIONS

AIIS	Anterior Inferior Iliac Spine
AON	Accessory Obturator Nerve
ASA	American Society of Anaesthesiology
ASIS	Anterior Superior Iliac Spine
cPNB	continuous Peripheral Nerve Block
DVT	Deep Vein Thrombosis
EA	Epidural Anaesthesia
ERAS	Enhanced Recovery After Surgery
ESPB	Erector Spinae Plane Block
FI	Fascia Iliaca
FICB	Fascia Iliaca Compartment Block
FN	Femoral Nerve
FNB	Femoral Nerve Block
IL	Inguinal Ligament
IM	Iliacus muscle
IPE	Ilio-Pubic Eminence
IPM	Ilio-Psoas Muscle
LA	Local Anaesthetic
LFCN	Lateral Femoral Cutaneous Nerve
LPB	Lumbar Plexus Block
MMA	Multimodal Analgesia
MMT	Manual Muscle Testing scale
NRS	Numerical Rating Scale
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
ON	Obturator Nerve
PACUs	Post Anaesthesia Care Units
PAI	Periarticular Infiltration
PENG	Pericapsular Nerve Group Block
PFN	Proximal Femur Nailing
PNBs	Peripheral Nerve Blocks
PROSPECT	Procedure-Specific Postoperative Pain Management

RA	Regional Anaesthesia
SIFI	Supra Inguinal Fascia Iliaca Block
SPNB	single-shot Peripheral Nerve Block
THA	Total Hip Arthroplasty
US	Ultra Sound
USG	Ultrasound-guided
VAS	Visual Analogue Scale

ABSTRACT

Introduction: Hip procedures are performed routinely these days & are associated with significant amount of pain. Adequate analgesia is crucial post-operatively to enhance dynamic-pain relief, early patient recovery and reduced hospital stay. Peripheral nerve blocks can efficiently reduce this pain enhancing overall patient outcomes.

Aims and objectives: To compare the efficacy of Pericapsular nerve group (PENG) block with Supra-inguinal fascia iliaca (SIFI) block for postoperative analgesia in hip surgeries for static pain-relief that is pain at rest and dynamic function that is degree of functional mobility post-surgery.

Materials & methods: A prospective, double-blinded randomized-study was conducted in 60 adult patients (ASA- I to III grade) undergoing hip surgeries & patients were randomly allocated to group P and S. After sub-arachnoid block, USG-guided PENG block was performed in group P and USG-guided SIFI block in group S. Postoperative analgesic efficacy was compared by comparing VAS scores at rest at 24 hours and functional mobility was assessed at 24 and 48 hours postoperatively by assessing the quadriceps muscle strength and maximum weight-bearing possible. Data collected was statistically analysed.

Results: Mean VAS scores were significantly lower in group P at 24 hours post-surgery than group S. The duration of analgesia was significantly prolonged in group P along with lower mean opioid consumption. Mean quadriceps-muscle strength grades were significantly higher in group P at both 24 and 48 hours and more patients in group P achieved higher grades of weight-bearing than group S at 24 hours post-surgery. This was also evidenced by improved satisfaction scores in PENG group.

Conclusion: PENG block is more effective than the SIFI block for post-operative analgesia in hip surgeries and demonstrates a significant motor-sparing effect that contributes to improved functional outcomes in patients' post-surgery.

Keywords: Pericapsular nerve group (PENG) block, Supra-inguinal fascia iliaca (SIFI) block, Visual analog score (VAS).

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INTRODUCTION

Hip procedures are widely popular surgeries performed in orthopedic practice today, encompassing treatments for fractures, degenerative diseases, hemiarthroplasties, and total hip replacements for osteoarthritis. [1] Pain is among the most frequently reported concerns raised by patients both pre-operatively and post-operatively, causing constant discomfort and debilitation, longer hospital stays, and readmissions after discharge. [2] These issues contribute to higher morbidity and mortality rates in these patients owing to the pain related to their fixation. Therefore, the need for adequate analgesia in the post-operative period cannot be emphasized enough, as early recovery is crucial for better functional outcomes following these surgeries and helps reduce complications. [3]

Pain itself is linked with multiple issues like hemodynamic instability due to acute overactivation of the sympathetic system, that can manifest as tachycardia, hypertension, hypoxia, arrhythmias, heart attacks, stroke, and elevated risk of venous thromboembolism due to prolonged immobility in the postoperative period, hence delaying early recovery and hospital discharge. [4,5] This increases both financial and emotional burden on these patients.

Multimodal analgesia (MMA) remains the preferred approach for pain alleviation in these patients while in hospital which includes the utilization of a wide variety of conventional oral or intravenous pain-killers like non-steroidal anti-inflammatory drugs (NSAIDs), opioids, or regional anaesthesia techniques like epidurals and various peripheral nerve blocks, which provide adequate analgesia, thereby facilitating early ambulation by decreasing dynamic pain and thus reducing the incidence of deep vein thrombosis (DVT), promoting early recovery, decreasing length of hospital stay, and improved patient satisfaction and outcomes following surgery. [6,7]

Systemic analgesia is the most frequently utilized method for addressing acute pain in the Post Anaesthesia Care Units (PACUs). For this purpose, a combination of opioid analgesics along with paracetamol or NSAIDs are commonly employed but they seem ineffective in some cases. [8] Opioids although effective analgesics, are related to several side effects, the key ones are respiratory depression; constipation; nausea; vomiting; drowsiness; impaired cognitive function following administration, tolerance, addiction and potential for future risk of substance abuse. [8,9] Additionally, they necessitate more aggressive monitoring and careful titration, especially among elderly individuals with multiple underlying co-morbidities. [10] Effective peri-operative analgesia that minimises the need for opioids and related adverse effects is therefore essential, specifically in this population.[1]

According to the "Procedure-Specific Postoperative Pain Management (PROSPECT) guidelines for Total Hip Arthroplasty," the regimen for pain control should incorporate "pre-operative or intra-operative paracetamol and cyclo-oxygenase-2-selective inhibitors or NSAIDs, continued postoperatively, with opioids reserved as rescue analgesics". If these medications are contraindicated, regional analgesia (RA) methods like the fascia-iliaca block or local infiltration of analgesia are suggested. "Femoral nerve block (FNB), Lumbar plexus block (LPB), intrathecal morphine, and epidural analgesia (EA) may also be considered, especially for patients who cannot use standard analgesics or are expected to experience high postoperative pain". [11]

However, certain studies focus on "Enhanced Recovery After Surgery (ERAS) protocols" which emphasize methods of pain relief that are easy to administer, have minimal major side effects, and focus on the usage of single, efficacious interventions and broad techniques, like RA techniques or strategies aimed at minimizing opioid use. [12]

Hence, comes the importance of regional anaesthesia approaches like peripheral nerve blocks (PNBs) for post-operative analgesia following surgeries. Research has shown that PNBs provide effective regional

analgesia that is superior to other modalities like pain medications and general anaesthesia which are linked to more systemic side effects. These blocks offer effective means of pain control for prolonged hours after surgery if applied efficiently and carefully, reducing both the need for and amount of postoperative parenteral analgesic requirements, especially opioids. [13]

Although central neuraxial blockades like continuous epidural anaesthesia and lumbar plexus blocks (LPB) are also administered for hip surgeries and are effective analgesics in the postoperative period, performing these neuraxial blocks is approached with caution as they might lead to prolonged motor block due to deep nerve block along with an increased frequency of hypotension and hemodynamic instability if used in higher doses or for prolonged periods, requiring continuous monitoring. This can prolong hospital stays and delay discharge. [14]

Central neuraxial blockade like epidurals are additionally linked to multiple complications, such as epidural hematomas, accidental dural puncture (wet tap), headaches, backaches, catheter displacement, systemic absorption, accidental intravascular, subarachnoid, or subdural injections, and nerve damage. [15]

PNBs, which are frequently used nowadays, for surgeries of the extremities, have the advantage of potent analgesia with minimal systemic complications (as they confine anaesthesia to the surgical region) compared to parenteral analgesics and central neuraxial blockades. They also have less motor blockade compared to central neuraxial techniques, leading to early patient recovery and discharge from the hospital. [16]

Hence, a diverse array of PNBs have been devised over time, including lumbar plexus blockade, femoral nerve blockade (FNB), sciatic nerve blockade to deliver postoperative analgesia. [17] Although these blocks are commonly performed, they do not provide complete analgesia as sparing of the articular accessory nerve occurs along with significant

lower limb weakness due to motor blockade which can impede early mobility of the patients and therefore, are likewise connected with an amplified risk of postoperative falls, hence increasing debilitation. [18,19] So, pain management protocols for hip surgeries nowadays aim at providing adequate analgesia with limited motor involvement. [18] Motor-sparing nerve blocks as a part of MMA protocol include “Pericapsular nerve group (PENG) block, Fascia iliaca compartment block (FICB), Lumbar erector spinae plane block (ESPB), Quadratus lumborum block, and periarticular infiltration of hip with local anaesthetic”, which do not cause motor blockade of the quadriceps muscle, hence helping in early ambulation of the patient. [20]

Pain arising in the hip joint is felt in the groin, down the front of the thigh, and sometimes in the knee due to its complex innervation from multiple nerves. Complete analgesia for surgeries like hip arthroplasty is achieved with the blockade of the femoral nerve, obturator nerve, nerve to the quadratus femoris, superior gluteal nerve, and sciatic nerve. Individually anaesthetizing all these nerves is cumbersome. [14] Single-shot injections that provide adequate pain coverage should therefore be employed.

The anterior capsule of the hip is innervated by the sensory articular branches of the femoral nerve (FN), accessory obturator nerve (AON), and obturator nerve (ON). [2,19] An anatomical study by Short et al. in February 2018 observed that the FN and ON consistently provide innervation to the anterior part of the hip capsule. They also discovered that the AON is present in a higher percentage of specimens than previously suggested (54% vs. 8-29%), and the higher branches of FN and AON were found to play a significantly larger role than previously reported. These branches were found to traverse close to the periosteum between the ilio-pubic eminence (IPE) and anterior inferior iliac spine (AIIS), both of which can be easily visualised by ultrasound and later, formed the landmarks for the application of the PENG block. [1,21]

Another recent study by Giron-Arango et al. in November 2018 discovered that the anterior capsule is the most richly innervated section of the hip joint, suggesting these nerves should be the main target for hip analgesia. Based on their observation, they developed an ultrasound-guided (USG) technique for blocking these nerves called the Pericapsular nerve group (PENG) block. [1] It targets only the sensory articular branches of the anterior capsule and blocks FN, ON, and AON at the same time, thereby providing effective pain relief, minimizing the use of opioids, and enabling dynamic hip movements by sparing of quadriceps muscle in subjects undergoing hip fracture surgeries in the post-operative period. [1,22,23] This block provides more complete analgesia to the hip by depositing a local anesthetic in the myofascial plane between the psoas muscle and the superior pubic ramus, containing high articular branches of these nerves. [1,21]

The Fascia-iliaca compartment block (FICB) is another alternative used widely nowadays for providing satisfactory postoperative pain-relief for patients undergoing hip surgeries.[24] The lateral thigh, receives innervation from the “lateral femoral cutaneous nerve (LFCN)”, which is not anesthetized by the PENG block. However, the FICB anesthetizes the LFCN along with the femoral and obturator nerves, thereby covering the site of incision in most of these surgeries, typically located at the junction of the medial and lateral thigh, about 2 cm from the Anterior Superior Iliac Spine (ASIS). A potential downside is that it can cause lower limb weakness due to motor blockade. [24,25]

An ultrasound-guided Supra-inguinal fascia iliaca (SIFI) block, a newer and improved approach to FICB, has been suggested as a new approach for performing FICB in recent years. Compared with the traditional approach, it positions the puncture needle towards the head, facilitating better spread and enhanced pain-relieving effects with minimal medication. [26] Chen L et al. in 2021 performed a study to appraise the early analgesic effects of USG supra-inguinal FICB in elderly subjects with hip bone fractures in the emergency department

and found that it offered effective pain relief and improved exercise tolerance compared to the traditional infra-inguinal approach in these patients. [27]

Another study by Zheng T et al. in 2021 has also shown SIFI block to minimize opioid consumption, and pain scores following hip surgeries, especially total hip arthroplasty. [9,28] It involves anterior access to the lumbar plexus via the supra-inguinal approach, superficial to the iliacus muscle, blocking both the FN and LFCN completely. [18,29] As they nerves are not branched off and have a more consistent course at this location, it may lead to involvement of the motor component as well, and hence might be associated with quadriceps muscle weakness, potentially delaying ambulation. [9,19]

The PENG block has the advantage of motor sparing as it does not block the quadriceps femoris, hence improving dynamic pain scores and promoting early ambulation of the patient post-surgery. However, it does not block the LFCN, so the lateral aspect of thigh remains sensitive, potentially leading to postoperative pain at the incision site following hip surgeries. On the other hand, SIFI has the advantage of blocking LFCN, thus covering the lateral aspect of the thigh, but might spare AON, not providing complete joint analgesia, and involves the disadvantage of motor blockade of the quadriceps femoris, which leads to delayed ambulation post-surgery.

Hence, the objective of this study was to compare the efficacy of the Pericapsular nerve group (PENG) block versus the Supra-inguinal fascia iliaca (SIFI) block in hip surgeries with regard to both sensory aspects by comparing the post-operative pain scores and motor aspects by comparing the functional mobility after surgery in both groups to determine which block is superior for overall patient management.

AIMS AND OBJECTIVES

To compare the efficacy of ultrasound-guided Pericapsular nerve group block (PENG) with Supra inguinal fascia iliaca (SIFI) block for postoperative analgesia in hip surgeries for static pain relief that is pain at rest and dynamic function that is degree of functional mobility possible post-surgery.

REVIEW OF LITERATURE

The International Association for Study of Pain (IASP) defines ‘pain’ as an unpleasant sensory and emotional experience associated with, actual or potential tissue damage. [30] Recognized as the "fifth vital sign" by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), pain management is essential throughout the entire patient care process, from hospital admission to outpatient follow-up as effective pain management is crucial for promoting healing, shortening recovery time, and improving patients' quality of life after surgery. [31] Inadequate pain management can even lead to legal consequences.

Hip fracture surgery is a frequent procedure among older adults. In 2000, around 1.6 million hip fracture surgeries were conducted globally, and this number is projected to increase to 6.3 million by 2050. [32] Also they are extremely painful and require effective pain management to avoid complications. Pain can trigger a stress response to prevent further damage to the tissue or to the organism itself. But if prolonged, it consumes cell and tissue capacity to respond in a physiological way and causes pathophysiological disbalance that not only fails to protect tissues effectively but also contributes to morbidity and mortality.[33]

Total hip replacement (THR) surgeries are also linked with significant perioperative pain, which can extend hospital stays and elevate morbidity and healthcare costs. [34,35] While many guidelines propose that early surgery can alleviate pain and diminish the potential for postoperative complications and mortality, managing perioperative pain remains a formidable obstacle for both patients and orthopedic surgeons.

Elderly patients pose particular challenges in pain management due to the limitations of NSAIDs and the potential side effects of opioids. [33] The need for effective analgesia after hip fractures and hip arthroplasty surgeries is therefore crucial. Advances in post operative pain management have greatly enhanced outcomes for these procedures.

However, significant post-operative pain may necessitate higher opioid doses in post-anesthesia care units (PACUs), a practice that should be minimized. [1,8]

One way to achieve this is by using multimodal analgesia approach which employs utilizing several modalities of pain control to obtain adequate pain control while mitigating opioid-associated side effects. It combines various techniques and types of analgesics with varying mechanisms of action. [6] This strategy introduced and popularized by Professor Henrik Kehlet as “Enhanced Recovery After Surgery (ERAS) includes preoperative, perioperative, and postoperative care and involves collaboration among patients, surgeons, anesthesiologists, physiotherapists, occupational therapists, and nursing staff.” Multimodal analgesia uses a combination of methods—such as psychotherapy, physical therapy, regional anesthesia, local injections, and non-opioid medications—to manage pain effectively. This approach provides better pain relief, speeds up recovery, and lowers the demand for opioids, thereby reduces opioid dependence and potential abuse. [36] Studies have demonstrated a decrease in hospital stays and pain levels in the initial 24-hour period after foot and ankle surgery. Adding periarticular injections to standard pain management for hip hemiarthroplasty has decreased postoperative opioid use. Similarly, surgical site injections for femoral fractures and upper extremity procedures have led to refined pain management and higher patient satisfaction.[37] Embracing multimodal analgesia is key to improving patient outcomes and ensuring comprehensive pain control in orthopedic surgery.

Regional anesthesia (RA) techniques are particularly valuable in context of MMA as they offer several benefits. They provide better overall pain control, lower the postoperative opioid requirements, improve dynamic pain management, reduce patient morbidity and mortality, decrease financial burden and enhance overall patient satisfaction. [6] It can reduce the need for general anesthesia during surgery, and in some cases, it can even eliminate the need for general anesthesia entirely. This is

particularly advantageous for patients at risk of cognitive dysfunction from general anesthesia. [38] Additionally, in surgeries such as total hip arthroplasty (THA), regional anesthesia is linked with positive outcomes like reduced blood loss and lower rates of deep vein thrombosis (DVT). [39,40] Therefore, various regional anesthesia methods have been developed and combined over time to manage post-operative pain effectively. [20]

These techniques include neuraxial local anesthetics and opioids, peripheral nerve blocks, and wound infiltration. The use of regional anesthesia is on the rise compared to general anesthesia because it allows for quicker mobilization, better pain relief, and less post-operative nausea and vomiting. [41]

Epidural analgesia (EA) is very commonly used for pain management in lower limb orthopedic surgeries. Epidural anaesthesia with an indwelling catheter ensures pain alleviation for longer periods, however, it can result in serious albeit uncommon complications like epidural hematoma, catheter displacement, nerve damage or epidural infection. [42] Furthermore, administering epidural local anaesthetic alone is linked with the potential for motor blockade, and delayed mobilization. Out of all the regional anaesthesia techniques, nerve blocks are reported to be more effective for peri-operative pain management than other analgesic techniques. PNBs confine anaesthesia to the surgical region, therefore avoiding side effects of neuraxial blocks. Improved ultrasonography techniques have also made regional anesthesia more reliable and effective. [43]

In a recent Cochrane systematic review, the use of PNBs to systemic analgesia for managing pain after elective hip replacement surgery in adults was compared. The review revealed that PNB led to lower postoperative pain levels, higher patient satisfaction, and reductions in both postoperative delirium and hospital stay duration. [44]

Calum R.K. Grant et al. in April 2008 studied the contribution of RA in providing analgesia for “Primary Hip and Knee Arthroplasty”. They considered combining various classes of pain-relieving medications and techniques important to facilitate early rehabilitation like epidural and spinal analgesia along with intrathecal opioids, single-shot or continuous PNBs like LPB, FNB, Fascia-iliaca block, sciatic nerve block, etc. They discussed regional anesthesia has several advantages over general anesthesia for hip and knee surgeries as they are linked with less intra- and postoperative blood loss due to reductions in mean arterial pressures and veno-dilatation, lower risk of venous thromboembolism, and better immediate post-operative pain relief, especially when combined with hydrophilic opioids like morphine. [20] A multimodal analgesic approach, incorporating continuous peripheral nerve blocks, low-dose intrathecal opioids, and regular oral analgesics such as paracetamol and long-acting opioids, is crucial for effective pain management and rapid patient mobilization. Intrathecal-morphine and LPB are highly effective for post-surgical analgesia in THA, while continuous PNBs are preferred for total knee arthroplasty due to their effective analgesia and fewer side effects compared to epidurals or opioids. Using low concentration local anesthetic solutions in these nerve blocks helps minimize motor block, ensuring better post-operative recovery. [6,20,45]

Since then, various nerve blocks have been evaluated and compared for their effectiveness in pain relief and facilitating early mobilization following hip surgeries. These techniques aim to reduce systemic complications and are particularly beneficial for elderly patients, offering better overall acceptance.

In a review by G. Joshi and Shelby L. Corman, the benefits and drawbacks of continuous peripheral nerve blocks (cPNB) were compared to single-shot peripheral nerve blocks (sPNB). While cPNB, addresses the issue of short-lasting analgesia seen with sPNB, thus avoiding the need for larger or more concentrated doses of local

anaesthetics (which increase toxicity risk), it has its own set of challenges. These include higher costs, risks of catheter dislodgement, obstruction and leakage at the catheter site, and potential bacterial colonization at the epidural site. Moreover, cPNB may not be suitable for all patients, particularly those with certain comorbidities or those unwilling to use this method. [46]

An anatomical study by Short and Baig examined the nerve supply to the anterior part of hip capsule, the main source of pain, and identified how high br. of the FN and ON relate to bony landmarks. They found that anterior capsule of the hip is supplied by FN, AON, and ON. The br. of FN and ON provide 100% of the innervation, while the AON contributes to 54% of nerve supply to the hip capsule. The FN branches enter the iliacus muscle (IM) at the L4-L5 level, travel beneath the psoas muscle and tendon amidst AIIS and IPE, and then supply the hip capsule. The AON travels beneath the medial psoas muscle around the L5 9 level, passing deep to the psoas around the IPE to reach the anteromedial joint capsule. [21] High articular br. of the FN (arising above the inguinal ligament) innervates all the four quadrants of hip joint capsule, and also the ON has high branches that arise proximally in the obturator canal. This anatomical arrangement explains the limited effectiveness of FNBs and 3-in-1 blocks in managing hip fracture pain. [47]

Another anatomical study by Birnbaum K et al found differences in the sensory nerve supply of the front and back of the hip joint capsule. The study demonstrated that the branches from FN innervates the anterior, and anterolateral regions, the ON supplies the anteromedial region, the superior gluteal nerve innervates the posterolateral region, and the articular br. from the N. to quadratus femoris and sciatic nerve provide innervation to the dorsal region of hip capsule. [48]

In a study by Gardner et al. the nerve distribution of the hip joint was examined through dissections of adult joints and sequential sections of fetal joints. They reported that articular nerves to hip arise from FN, ON,

and, superior gluteal nerves, N. to the quadratus femoris, AON and perhaps from the branches of lumbar sympathetic ganglia. [49]

Recently, Giron et al. in 2018 conducted a study in five patients and described a new RA technique for managing distress caused by hip fractures and evaluated these patients for mobility. This method uses a low-frequency curvilinear probe to deliver local anesthetic into the Musculo-fascial plane amongst the psoas tendon in the front and, IPE in the back (Fig.1). This ultrasound-guided technique, called the PENG block, targets the sensory br. of the FN and the AON with a single injection. The authors used a single injection block of local anesthetic solution containing 20 ml of 0.25% bupivacaine with 1:400,000 epinephrine in 4 of 5 cases and with 1:200,000 epinephrine plus 4 mg of dexamethasone in one case. Thirty minutes after the block, patients were asked to flex their hips. All patients complied and reported markedly diminished pain scores compared with baseline, and none exhibited clinically evident quadriceps weakness. [1]

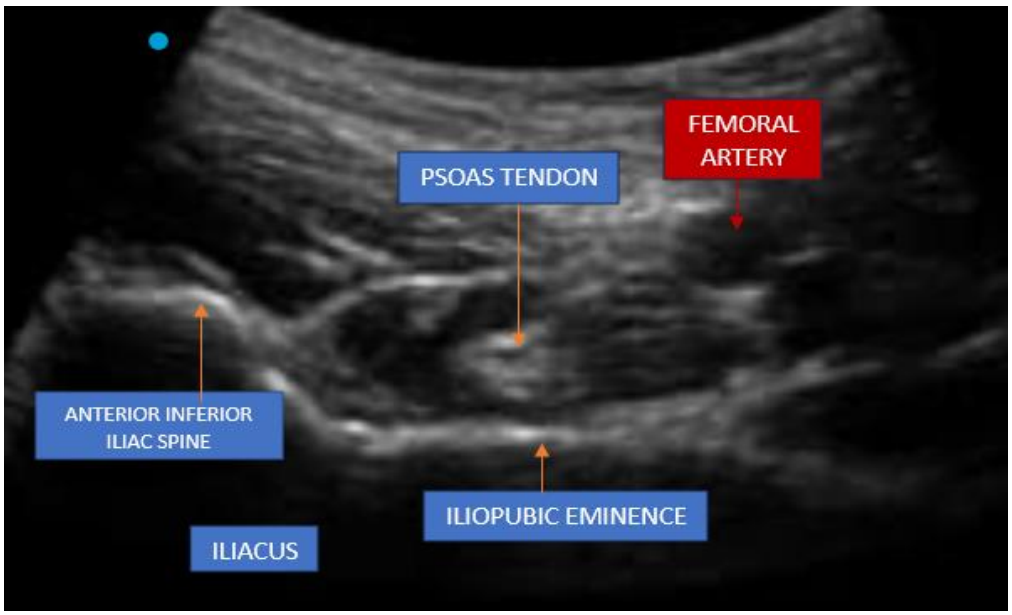

Figure 1: Sono anatomy of PENG block with important landmarks. The local anaesthetic is deposited in the fascial plane between the psoas tendon and the iliopubic eminence.

G Pascarella et al. in July 2021 conducted a study in sixty patients and assessed the efficacy of PENG block in subjects undergoing THA with spinal anaesthesia, measuring pain scores, total opioid use, mobilization, and hospital stay. The subjects were classified into two groups: one group received the PENG block, while the other group did not receive any form of block. All patients received MMA in the form of acetaminophen, ketorolac, and dexamethasone given intravenously pre-surgery and wound infiltration with 0.375% ropivacaine 20 ml volume. Post- operative analgesia administered was ketorolac 60mg iv every 24 hours, acetaminophen I gm iv three times a day and 15mcg of sufentanil tablets via patient-controlled analgesia (PCA) pump. The patient group who received the PENG block had markedly diminished NRS pain scores compared to those in the control group throughout all measured time periods. Sufentanyl was required in all patients and 20 patients in control and PENG group respectively. Also range of motion (ROM) was significantly better in the PENG group. Every patient in control group used sufentanil tablets, while 10 patients (33%) in PENG group did not take any. Total opioid consumption was median (IQR [range]) 2 (0–2 [0–9]) sufentanil tablet administration in the PENG group vs. 5 (3–6 [2–9]) of the control group ($p < 0.001$,), which is equivalent to 4.0 (4.5) vs. 8.9 (4.0) morphine mg. The mean time until first opioid administration in the PENG group was 6 hours delayed than the control group. Hence, they concluded that PENG block is an effective opioid sparing analgesic technique leading to early postoperative mobilization and can be considered as a valid analgesia option for hip surgeries. [22]

D Roriz et al. in 2021 also conducted a similar study in eight patients in which they found that PENG block may be a safe and useful analgesic technique with a potential motor blocking-sparing effect and showed decrease in opioid consumption postoperatively, thus reducing the opioid-related adverse effects. [23]

In a recent randomized trial published in 2023 by Kukreja P et al. involving 112 patients who underwent THA under spinal anesthesia,

researchers compared the PENG block against no block and learned that the patient group which received the PENG block reported significantly better quality of recovery at both 24 and 48 hours postoperatively, as measured by the QoR-15 questionnaire and also used less opioids. These results suggest that combining a PENG block alongside standard multimodal analgesia could improve recovery quality and reduce opioid intake following THA. [50]Motor sparing pain relief methods for hip surgeries became popular eventually which provide pain relief without blocking the motor component of the nerve, thereby facilitating early ambulation, and reducing the incidence of DVT and pulmonary embolism in patients undergoing hip surgeries.

A comprehensive systematic review of literature by Morrison C et al. adhering to the “Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines” Joanna Briggs Institute framework” summarized 20 studies on the PENG block out of the 345 articles yielded by database screening. They found that the PENG block effectively provides pain relief in various hip-related procedures, reducing the need for opioids. When combined with local anesthetic infiltration or other nerve blocks, such as FNB or LFCN block, it offers broader sensory coverage and potentially enhances pain management outcomes compared to traditional methods of regional analgesia leading to increased patient satisfaction and fewer opioid-related complications postoperatively. [51]

In 1989, Dalen et al. conducted a study to evaluate the effectiveness and reliability of a “new anterior approach for the lumbar plexus block (LPB)” called the “Fascia Iliaca Compartment Block (FICB)”. The "fascia iliaca compartment" is a triangular area where the FN, LFCN, and ON travel for a significant portion of their pathways. [52] Its boundaries are defined as follows:

1) anteriorly by the inner aspect of the fascia-iliaca, which covers the IM and extends medially to cover various aspects of the psoas muscle;

2) posteriorly by the outer aspect of the iliacus muscle;
3) medially by the vertebral column and the superior part of the sacrum; and
4) rostrally and laterally by the inner lip of the iliac crest, where the fascia is firmly attached.

They compared this novel technique to the “3-in-1 block procedure” in lower limb surgeries in 120 pediatric patients. The FICB involved a "2-pop" technique, where the first "pop" was felt as the needle crossed the fascia lata, and the second "pop" as it crossed the fascia iliaca. Both blocks were administered using a landmark technique with an anesthetic solution of 1% lidocaine and 0.5% bupivacaine, both containing epinephrine at a ratio of 1:200,000. The study found that the group receiving the FICB experienced better analgesia and a higher degree of sensory blockade of the lumbar plexus nerves supplying the thigh, using reasonable amounts of local anesthetic, compared to the 3-in-1 block. [52]

This was also supported by a study published in 2019 whereby the anatomy of fascia-iliaca compartment and its relation with femoral nerve, LFCN, and ON was described in depth. At its distal end, the fascia-iliaca surrounds the FN and goes below the lacuna vasorum’s FA and vein, according to N. O'Reilly. [24] From the 2nd to 4th lumbar nerve roots, the FN goes via the PM muscle fibers and descends between the iliacus and psoas. Outside the pelvis, it lies in front of iliopsoas muscle and femoral vessels. The 2nd and 3rd lumbar nerve roots give rise to the ‘lateral cutaneous nerve of thigh (LCNT)’, which runs deep to the fascia-iliaca, and exits the fascial plane near the IL. From the 2nd to 4th lumbar roots, the ON supplies some inner thigh skin and is mostly a motor nerve. Before reaching the obturator foramen, the ON passes behind the common iliac artery after exiting the fascia-iliaca compartment. LA beneath the fascia-iliaca anesthetizes the FN, ON, and LCNT since they start in there. FICB anaesthetizes the genitofemoral nerve, running on the front of psoas muscle behind the fascia iliaca. This safe and

straightforward method blocked all three nerves to provide pain alleviation for surgeries involving hip and femur. [24]

In a systematic review of 27 randomized controlled trials involving 2478 cases, Wan et al. in 2020 assessed the efficacy of FICB for managing perioperative pain in geriatric patients with fractures of hip. They found that FICB provides comparable or greater pain relief compared to traditional methods both prior to and following surgery. FICB was found to facilitate easier spinal anesthesia administration, reduce the need for additional pain medication, promote early mobility, and potentially mitigate complications in this patient population. [53]

In 2007, Stevens proposed a modified version of the landmark-guided FICB originally described by Dalens. Instead of advancing the needle 0.5 cm below the IL as in Dalens' method, Stevens' technique involved inserting the needle at a right angle 1 cm above the inguinal ligament (IL). He hypothesized that injecting 40 mL local anesthetic (LA) above the IL would block the lumbar plexus at a higher level. His study found a significant reduction in consumption of morphine at 24 hours (22 mg compared to 37 mg) when employing this method compared to a sham block. [54]

In 2008, Dolan was first to explain the application of ultrasound for FICB, which enabled greater accuracy for needle placement and better deposition of LA below the fascia iliaca. This study illustrated that the US-guided FICB resulted in increased incidence of sensory loss in the medial part of thigh and more frequent motor blocks of the FN and ON.[55]

Hebbard et al. introduced a new ultrasound-guided supra-inguinal technique in 2011 for the FICB by performing this method on over 150 patients and conducted a study on six un embalmed cadavers. They theorized that injecting local anesthetic (LA) above the IL inside the fascia iliaca (FI) compartment could be advantageous because the LFCN exits the FI plane at the IL, and branch of the FN to the iliacus muscle and acetabulum leave proximal to the IL. To execute the block,

Hebbard positioned the ultrasound (US) probe perpendicular to the IL, near the ASIS, in a cranio-caudal orientation. This provided a clear view of the FI, sartorius muscle, iliopsoas muscle (IPM), and abdominal internal oblique muscles. The probe was subsequently moved downward and inward along the IL, ensuring it stayed lateral to the FA and FN. The needle was inserted 2-4 cm below the IL and advanced through the FI at the IL. Initially, 1 mL of LA was injected to form a small pocket under the FI. The needle was subsequently advanced into this pocket, and more LA was injected using hydro-dissection, allowing the needle to move upwards, deep into the FI compartment, towards the iliac fossa. A successful injection was indicated by a good upward spread of LA under the FI (Fig. 2). [56] In 150 patients, 20 ml LA effectively blocked both the LFCN and the FN. This was confirmed in the cadaver study, where 12 supra-inguinal FICBs were performed with 20 mL of aniline blue. The FN was stained in all cases, the LFCN in 10 out of 12 cases, and the ilioinguinal nerve in 7 out of 12 cases. However, the study had limitations in assessing the involvement of the obturator nerve (ON). [57]

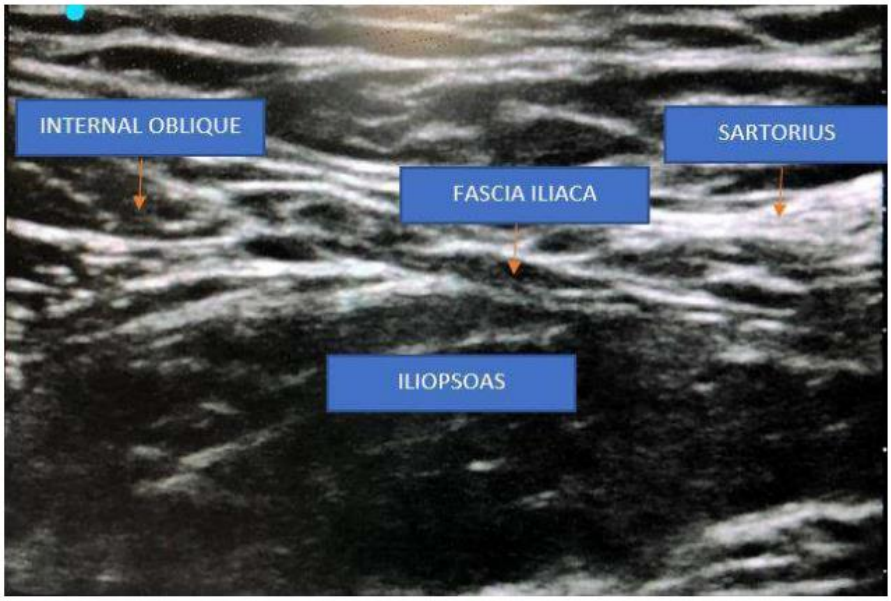

Figure 2: Sono anatomy of SIFI block with important landmarks. The “bow-tie” appearance formed by the internal oblique and sartorius muscle can be seen. The local anaesthetic is deposited deep to the fascia iliaca superficial to the iliopsoas muscle.

Desmet et al. investigated the efficacy of a supra-inguinal FICB for pain management after THA. They modified Hebbard's technique by positioning the ultrasound probe to visualize a **"bow-tie sign"** (Fig. 2: orange) made by the iliacus muscle, sartorius muscle, and abdominal wall muscles. The needle was inserted 1 cm above the inguinal ligament, and 40 mL of 0.5% ropivacaine was injected. This approach, accessing the fascia iliaca higher than traditional methods, resulted in a 45% reduction in morphine use at 24- and 48-hours post-surgery, along with lower pain scores. The study highlighted successful sensory blockade of the obturator nerve in 86% of patients and simultaneous blockade of all targeted nerves (FN, LFCN, and ON) in 70% of cases. They hypothesized that 15 injecting a high volume of LA more proximally in fascia iliaca compartment results in a more successful targeting of the nerves. [26]

In 2015, Kumar et al. compared two approaches of FICB for postop management of pain in 40 patients undergoing THA. Group I received

FICB using the conventional infrainguinal approach, while Group S underwent the modified proximal suprainguinal approach. The techniques involved landmark-guided needle placement and injection of 40 mL of 0.2% bupivacaine after confirming correct positioning. Group S demonstrated significantly lower consumption of morphine at 6-, 12-, and 24-hours post-block in comparison with Group I ($p < 0.05$), with markedly reduced cumulative 24-hour morphine use ($p < 0.0001$). Additionally, Group S experienced delayed first PCA morphine utilization ($p < 0.0001$) and lower demand frequency compared to Group I. They concluded that suprainguinal FICB produces more complete sensory block of the thigh compared with the infrainguinal FICB. [58] Similar findings were seen in another study done by Kris et al in 2019 using 40 ml 0.5% lidocaine. [59]

Zheng et al. carried out a study in 28 patients in which they found that SIFI provides an effective post-operative analgesic adjunct after THA with the satisfactory blockade of femoral, obturator and sciatic nerves when it is compared with the existing techniques for hip analgesia.[28] Another study by Gasanova et al. compared USG guided SIFI versus periarticular infiltration (PAI) of hip for pain management in 60 patients following THA, yet did not identify significant differences in the pain scores, time to ambulation and post-op opioid requirements between the groups. Muscle weakness was although found in the SIFI group at 6 hours post-operatively. [19]

Various studies were aimed to find out the ideal dose of 0.2% ropivacaine in FICB block and in a cadaveric study by Kris Vermeylen et al., it was found that almost 40 ml volume was required to block femoral, lateral cutaneous femoral nerve and obturator nerve while 20-30 ml was enough to block femoral and lateral cutaneous femoral nerve. [59]

Jadon et al. published a study in August 2021 comparing SIFI block with PENG block in sixty-six patients for positioning ease during spinal anesthesia. They found that PENG block provided superior pain relief and facilitated easier positioning during SAB in fractured hip patients undergoing scheduled hip surgery compared to SIFI block. [60] Similarly,

Kulkarni et al. in December 2021 conducted a study on 60 elective hip fracture patients under spinal anesthesia and separated them into Group FICB and Group PENG who received ultrasound-guided blocks with 20 ml of 0.25% bupivacaine. The study showed that both groups had similar NRS pain levels before and during spinal anesthetic positioning (p=0.853) and did not differ in anesthetist comfort during spinal anesthetic positioning or patient acceptability (p=0.553 and 0.504). [61]

Faramarz Mosaffa et al. in February 2022 published a study in which they found a significant reduction in VAS score in PENG group compared to FICB group after 15 minutes of block and 12 hours post-surgery. The time until the first analgesic was needed was also significantly longer in the PENG group indicating that PENG block is superior to FICB in providing hip fracture analgesia. [29] Similarly, K.S. Senthil et al. from India published a similar study done on forty patients in March 2022 with findings suggestive of PENG block as more appropriate analgesic modality than FICB patients showing notable differences in VAS scores and motor power of quadriceps femoris indicating potency of sensory blockade and motor sparing in PENG block patients than FICB. [18]

Yong Seon Choi et al. in March 2022 published a study done on 58 patients comparing PENG block versus SIFI for THA under general anesthesia and found that pain scores experienced while at rest were lower in PENG group than those in the SIFI group postoperatively at 6th and 24th hour but there were no notable differences in pain scores between the groups throughout 48 hours period post-operatively. Quadriceps strength and consumption of opioid were also alike in both groups under general anaesthesia. [62]

In a study by Liang et al. in August 2023, PENG block with LFCN block was compared with SIFI alone using 30 ml of 0.33% ropivacaine in 92 patients undergoing THA. Compared to the SIFI group, the PENG with LFCN block group showed earlier postoperative walking times (19.6 ± 9.6 hours vs. 26.5 ± 8.2 hours, $p < 0.01$), improved hip flexion at 6, 24,

and 48-hours post-surgery, and greater lower limb muscle strength at 6 hours (p = 0.03) suggesting PENG with LFCN block promotes early mobility and hip function after THA than SIFI. [63]

Carella M et al. in 2023 also compared PENG block with SIFI in 102 patients receiving posterolateral THA under spinal anesthesia. SIFI group underwent a 40-ml ropivacaine 0.375% supra-inguinal fascia iliaca block, while PENG group received a 20-ml 0.75% pericapsular nerve group block. They found that PENG pain scores were non-inferior to SIFI pain scores at 6 hours post-surgery (difference between medians 0, 95% CI -0.93 to 0.93). Pain trajectories, motor recovery (timed-up-and-go and walking tests), and quality-of-recovery scores were also not significantly different between groups. [64]

In a recent study by Liu et al. done in 2024, PENG block with LFCN block were compared to the FICB block in eighty arthroscopic hip surgery (AHS) patients. The study revealed that Group PENG/LFCN had considerably lower quadriceps weakness (28.2% vs. 76.9%, P < 0.001), higher muscle strength grades, and lower static pain scores up to 48 hours post-block (P < 0.001). Thay also had decreased dynamic pain levels at 6- and 12-hours post-block (P < 0.05) and additionally showed better recovery quality on the second postoperative day (P < 0.05) suggesting that PENG block paired with LFCN block reduces quadriceps weakness and pain and improves postoperative recovery for AHS patients better than FICB. [65]

Due to the varying outcomes observed in the existing studies comparing PENG with SIFI block, we undertook this study to compare their analgesic efficacy for providing static pain relief and to compare advanced post-operative dynamic pain relief, with a focus on their efficiency of improving functional mobility following hip surgeries.

MATERIALS AND METHODS

SOURCE OF DATA

A randomized double-blinded observational study was carried out in the "Department of Anaesthesiology, Dayanand Medical College & Hospital, Ludhiana" after approval from "Institutional Ethics Committee" on a total of 60 ASA- I, II, III adult patients undergoing hip surgeries for fractures, hemiarthroplasty and total hip arthroplasty under subarachnoid block who were randomly allocated to 2 groups of 30 patients each by computer generated randomization codes contained in sealed, sequentially numbered envelopes. Informed consent was obtained from all the patients.

METHOD OF COLLECTION OF DATA

INCLUSION CRITERIA

- Patients aged 40-85 years of age
- ASA Physical status I, II, III
- Electively scheduled for hip surgeries.
- Body Mass Index between 18-35 kg/m2

EXCLUSION CRITERIA

- Any known allergy to study drugs
- Contraindication to neuraxial blockade or peripheral nerve blocks
- Chronic opioid use
- Diabetic neuropathy
- Infection at the site of block

GROUP ALLOCATION

After informed consents were obtained in written, approximately sixty patients scheduled for undergoing hip surgeries including surgeries for hip fractures (neck of femur, intertrochanteric and subtrochanteric fractures of femur), dynamic hip screw fixation, proximal femur nailing and hemiarthroplasty, total hip arthroplasty (THA) were randomised into two groups of thirty patients each to receive either Pericapsular Nerve

Group Block (PENG) block (Group P) or Supra-Inguinal Fascia iliaca (SIFI) Block (Group S) along with the sub-arachnoid block as the primary anaesthesia technique for the procedure.

The randomization scheme used was prepared by our biostatistician via computer generated random numbers and those involved in the study were blinded to the group allocation. The allocation envelope was opened by an anaesthesiologist not directly involved in the clinical care of the patient. They prepared the local anaesthetic solution as per the group allocation and performed these blocks accordingly under ultrasound guidance. A blinded observer assessed pre-operative and post-operative pain scores. This observer was also not involved in the direct clinical care of the patient. The randomization codes were decoded by the end of the study.

PREANAESTHETIC CHECKUP

The pre-operative routine anaesthesia check-up was conducted 1-2 days before surgery for all the patients, which involved comprehensive history-taking, general physical and systemic examination, relevant haematological and radiological investigations, thereby optimising the patient for surgery. Demographic information such as age, sex, BMI, residence, and type of hip surgery was also recorded. Patients were explained about the study being conducted and written informed consent was obtained along with education on the usage of VAS scale.

Preoperative VAS at rest was noted before shifting the patient to the operating room (OR). All the patients received a standardised premedication regimen, unless contraindicated, in the preop period consisting of tablet pantoprazole 40 mg per oral and tablet alprazolam 0.25 mg per oral on morning of surgery with sips of water two hours prior to surgery.

ANAESTHESIA TECHNIQUE

On arrival in the OR, patients were positioned supine on the operating table and routine continuous monitoring in the form of 5-lead ECG, heart rate, non-invasive BP cycled every 2 minutes, temperature and pulse oximetry was done. All patients in both groups received subarachnoid block with total drug volume ranging from 2.8 to 3.2 ml consisting of fixed 0.5 ml of fentanyl (25 mcg) with varying volume of 0.5% hyperbaric Bupivacaine depending on patient height, weight, age, sex, and duration of surgery using a 26-gauge Quincke's spinal needle in sitting position under all sterile conditions. Immediately after the sub-arachnoid block, after achieving the required level of blockade with the patient in a supine position, respective ultrasound-guided blocks were administered in these patients according to the groups assigned to them.

BLOCK TECHNIQUE

Group P (PENG block)

Group PENG received pericapsular nerve group block performed under USG guidance. A curvilinear low frequency (2-5 MHz) ultrasound probe was originally placed in a transverse plane over the AIIS and then the probe was rotated in a counter-clockwise direction approx. 45 degrees to align with the pubic ramus. In this view, the ilio-pubic eminence, the iliopsoas muscle and tendon, the femoral artery, and pectineus muscle were visualised. A 21-gauge, 100 mm stimuplex ultra 360 (B BRAUN) needle was introduced from the lateral to medial direction in an in-plane approach, to place its tip in the musculofascial plane between the psoas tendon in the front and pubic ramus in the back. [66] 2 ml local anaesthetic 2% lignocaine was administered to verify the tip's position. After confirming the correct position and ensuring negative aspiration, 30ml 0.2% Ropivacaine along with 4mg dexamethasone was injected slowly, with careful observation for adequate fluid spread in this plane.

Group S (SIFI block)

Group SIFI patients received supra-inguinal fascia iliaca block using ultrasound guided supra-inguinal approach with a high frequency (6-14Mhz) linear probe in supine position. The ASIS was initially palpated and the FA was identified in the short-axis by placing the transducer in the inguinal crease. The sartorius muscle was identified by translating the transducer laterally from the FA. Sartorius was traced cephalad to ASIS insertion. Using this technique, the ASIS hypoechoic shadow was easily identified cranial to the sartorius insertion and iliacus muscle medial to ASIS shadow. After locating the ASIS and iliacus, the transducer's medial end was rotated to point at the umbilicus, the final location. Using the transducer in the final position, sonographic anatomy was identified from superficial to deep, including subcutaneous fat, internal oblique muscle, transverse abdominus muscle, fascia iliaca, and iliacus muscle. A 21-gauge, (B BRAUN) 100-mm stimuplex ultra360 block needle was advanced in-plane fashion from caudal to cephalad end to pierce the fascia iliaca. With the needle tip positioned just beneath the fascia iliaca, 2 mL local anaesthetic was injected to confirm the tip location.[24,52] After verifying the correct position, 30 mL 0.2% Ropivacaine with 4mg dexamethasone was incrementally injected into the fascia iliaca and iliacus muscle. Once the injection was given, the transducer was moved medially towards the FN, revealing caudomedial local anaesthetic spread.

Hip surgeries were performed in these patients and intra-op recording of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), respiratory rate (RR), oxygen saturation (SpO2) along with the recording of sensory level of blockade achieved was done at the start of the block and then every 30 minutes compared to baseline vitals of the patient. After completion of the procedure, the patients were shifted to PACU where post-operative vitals (HR, SBP, DBP, SpO2) along with VAS score at rest were monitored hourly for the first 4 hours, 2 hourly for the next 4 hours and then every 4 hourly till 24 hours post-operatively. A standardised analgesic regimen

if not contraindicated, comprising injection paracetamol 1 gram intravenously (iv) 8 hourly was given to all the patients.

FOLLOWING OUTCOMES WERE MEASURED POSTOPERATIVELY to analyse the efficacy of the blocks in relation to static pain relief that is pain at rest and dynamic function that is degree of functional mobility possible post-surgery.

- PRIMARY OUTCOME: Postoperative pain was evaluated using VAS pain scores at rest 24 hours after surgery in both groups where the score was obtained by asking the patient to rate the pain from 0-10 where a score of 0 will indicate 'no pain' to score of 10 indicating 'worst pain'. [67]

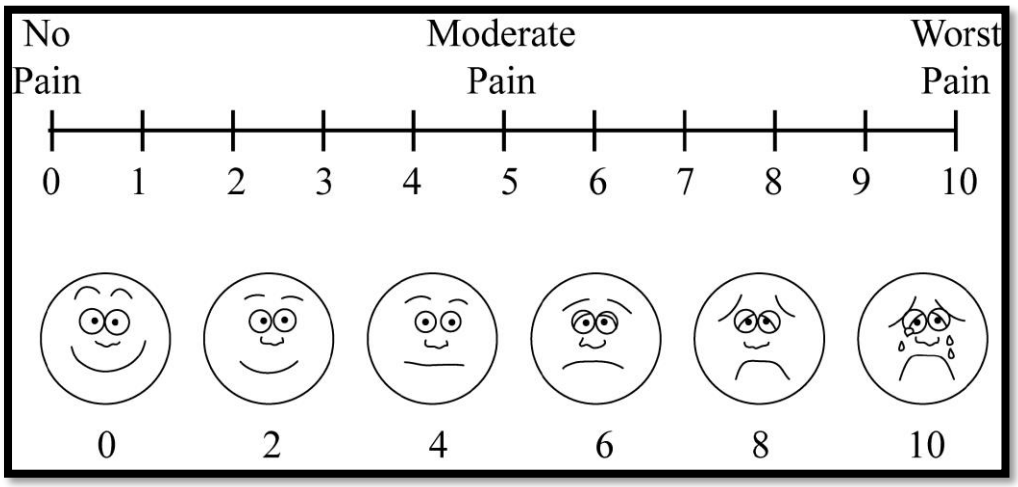

Figure 3: Visual Analogue Scale (VAS) for pain assessment- used to measure subjective pain intensity reported by patients ranging from 0 (No pain) to 10 (Worst pain imaginable).

- SECONDARY OUTCOME:

1. Functional mobility was assessed by:
   (a) QUADRICEPS MUSCLE STRENGTH: the method most widely accepted for assessing the muscle strength i.e. "The Oxford Scale Aka Medical Research Council Manual Muscle Testing (MMT) scale" was used where strength of the quadriceps muscle was assessed at 24- and 48-hours post-

surgery. The patient was positioned supine with hip flexed at 45 and knee completely flexed. The patient was asked to extend the knee while evaluating their strength on a scale of 0 to 5 against resistance and gravity.

Grade 0- complete inability to contract the muscle.
Grade 1- only a slight contraction or flicker of muscle.
Grade 2- moving leg through its complete range of motion, but only in a horizontal plane, not against the pull of gravity.
Grade 3- able to hold leg up off the table against the pull of gravity, but not able to withstand any additional pressure.
Grade 4- able to hold up leg actively against gravity and some resistance.
Grade 5- actively holding up leg against gravity and strong resistance. [68]

b) WEIGHT-BEARING: After hip surgery, it is of utmost importance to achieve the correct amount of weight-bearing for early recovery when moving around using crutches or walkers. Therefore, amount of maximum weight-bearing possible was assessed by following grades-

- At 24 hours using non-weight bearing (NWB) as Grade 1 where the leg did not touch the floor and was not permitted to support any weight at all or toe-touch weight-bearing (TTWB) as Grade 2 where the foot or toe may have touched the floor (such as to maintain balance) but was not permitted to support any weight whichever maximum the patient was able to perform.
- At 48 hours by assessing the maximum weight bearing the patient could perform- partial, tolerated, or full where:
    - Partial weight-bearing (PWB) or Grade 3 was a small amount of weight up to 50% which might be supported by the affected leg, permitting the patient to stand with their body weight evenly supported by both feet (but not to walk).

- Weight-bearing as tolerated (WBAT) or Grade 4 where the patient independently chose the weight supported by the extremity.
- Full weight-bearing (FWB) or Grade 5 where the leg could carry 100% of the body weight, permitting normal walking.[69]

Other secondary outcomes measured were:

2. The time to need for first rescue opioid analgesic after surgery was compared in both groups. Injection tramadol 50-100 mg i.v. was used as a rescue analgesic whenever VAS was $\geq$ 4 to a maximum of 400 mg within 24 hours following which, if VAS was still >4, another rescue analgesic, injection fentanyl 1mcg/Kg as a slow iv bolus was administered to the patient. [70]
3. The total opioid requirement in the initial 24 hours was compared in both groups.
4. Overall patient satisfaction for pain management within 24 hours was measured in both groups through a 5-point Likert scale.
5. Surgeon's satisfaction with anaesthesia services for overall pain management was measured through a 5-point Likert scale.

STATISTICAL ANALYSIS

Data was described in terms of range, mean ± standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. To determine whether the data was normally distributed, a Kolmogorov-Smirnov test was used. Comparison of quantitative variables between the study groups was done using Student t-test and Mann Whitney U test for independent samples for parametric and non-parametric data respectively. For comparing categorical data, Chi square ($\chi 2$) test was performed and Fisher exact test was used when the expected frequency was less than 5. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using (Statistical

Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

SAMPLE SIZE CALCULATION

It was assumed that the prevalence rate of hip surgeries in our hospital was 4.2% based on previous data.

Assumptions:

Mean Group (m1) = 2.10

Mean Group (m2) = 1.30

Coefficient of variation = 150%

Standard deviation Group (σ1) = 0.78

Standard deviation (σ2) = 0.57

The formula used is as follows:

$n = (\sigma 12 + \sigma 22) (Z\alpha + Z\beta)^2 / (m1 – m2)^2$

Where,

Zα = Value of standard normal variate corresponding to α level of significance (1.96)

Zβ = The standard normal deviate for desired power (2.34)

m = Average

σ = Standard deviation

With the above assumptions, the sample size for 95% confidence level & 99% power worked out to be 27 patients in each group for our study. This number was increased to 30 per group (total 60 patients) to allow for a predicted dropout from the study.

OBSERVATIONS AND RESULTS

This prospective randomized controlled study was conducted in the Department of Anaesthesiology, DMCH Ludhiana on a total of 60 adult patients belonging to ASA grade I, II & III scheduled for hip surgeries for fractures, hemiarthroplasties, and THA under subarachnoid block. The patients were randomly allocated into two groups of 30 patients each- Group P (PENG Block) and Group S (SIFI Block).

The study aimed to compare the efficacy of USG-guided Pericapsular nerve group block (PENG) with the Suprainguinal fascia iliaca block (SIFI) for post-operative analgesia in patients undergoing hip surgeries and dynamic function that is degree of functional mobility possible in these patients' post-surgery.

The following outcomes were noted:

- Assessment of pain using Visual Analog Score (VAS) starting at hour zero (0; initiation of block), hourly for the first 4 hours, 2 hourly for the next 4 hours and then every 4 hourly till 24 hours post-operatively compared to the pre-operative baseline values.
- Functional mobility by assessing quadriceps muscle strength and maximum weight bearing possible at 24 hours and 48 hours postoperatively.
- Time to need for first rescue opioid analgesia (duration of analgesia provided by the block).
- Total opioid consumption in first 24 hours.
- Patient satisfaction for overall pain management in 24 hours.
- Surgeon's satisfaction with anaesthesia services for overall pain management.

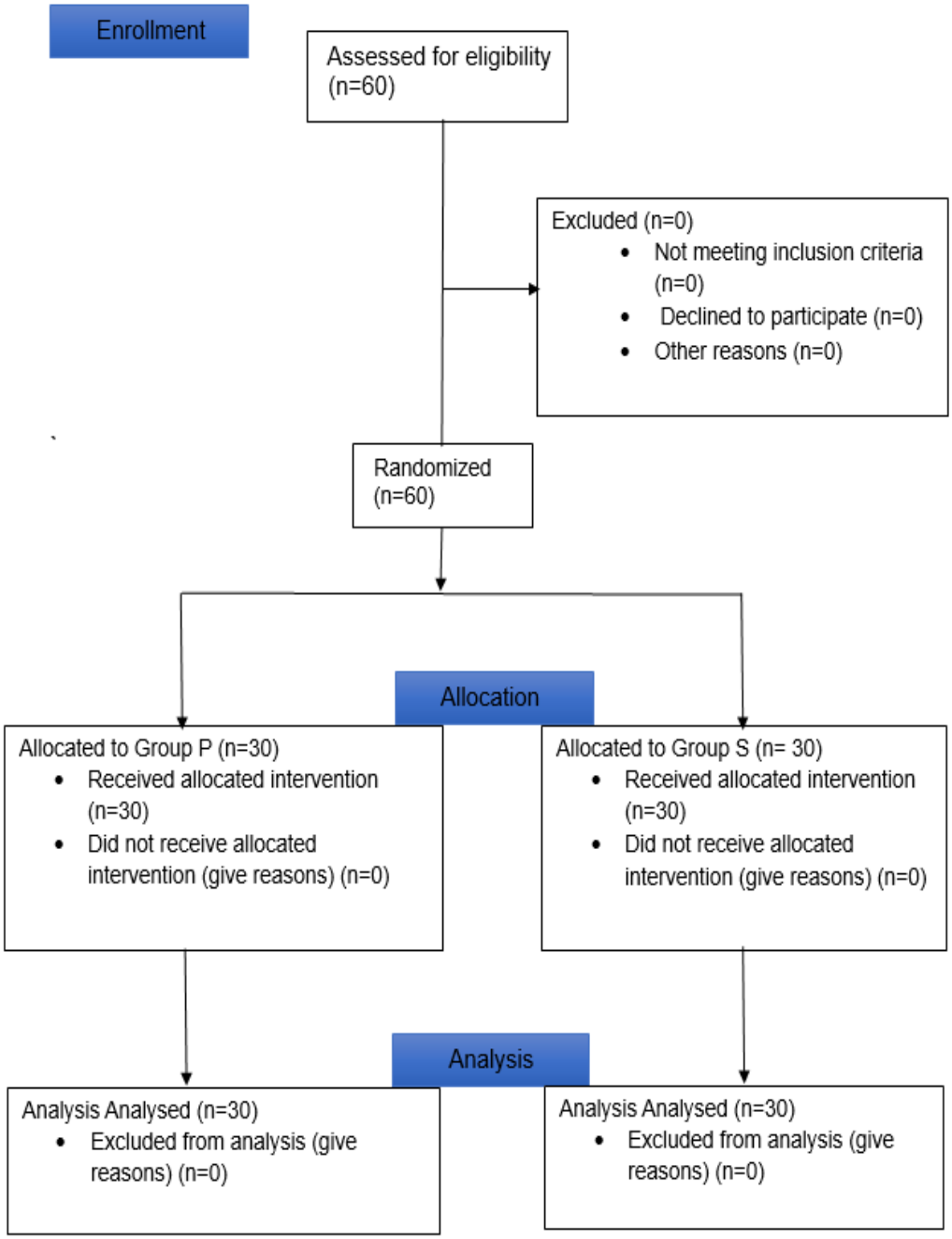
Enrollment
Assessed for eligibility (n=60)
Excluded (n=0)
Not meeting inclusion criteria (n=0)
Declined to participate (n=0)
Other reasons (n=0)
Randomized (n=60)
Allocation
Allocated to Group P (n=30)
Received allocated intervention (n=30)
Did not receive allocated intervention (give reasons) (n=0)
Allocated to Group S (n= 30)
Received allocated intervention (n=30)
Did not receive allocated intervention (give reasons) (n=0)
Analysis
Analysis Analysed (n=30)
Excluded from analysis (give reasons) (n=0)
Analysis Analysed (n=30)
Excluded from analysis (give reasons) (n=0)

Figure 4: CONSORT Flow Diagram of the study, n= number of cases.

A total of 60 patients were enrolled for the study according to the inclusion criteria and all of them completed the study. They were divided in 2 groups of 30 patients each and were randomly allocated to either of the groups by computer generated random numbers. All of them received the interventions and there were no dropouts. They were analysed using the statistical program for Microsoft Windows available in SPSS 21 version. [Figure 4]

DEMOGRAPHIC PROFILE:

In terms of demographic data, the groups showed no statistical differences.

Table 1a: DISTRIBUTION OF SUBJECTS ACCORDING TO AGE

	Group P		Group S		t	p-value
	Mean	SD	Mean	SD		
Age (years)	72.50	8.61	73.63	6.59	-0.573	0.569

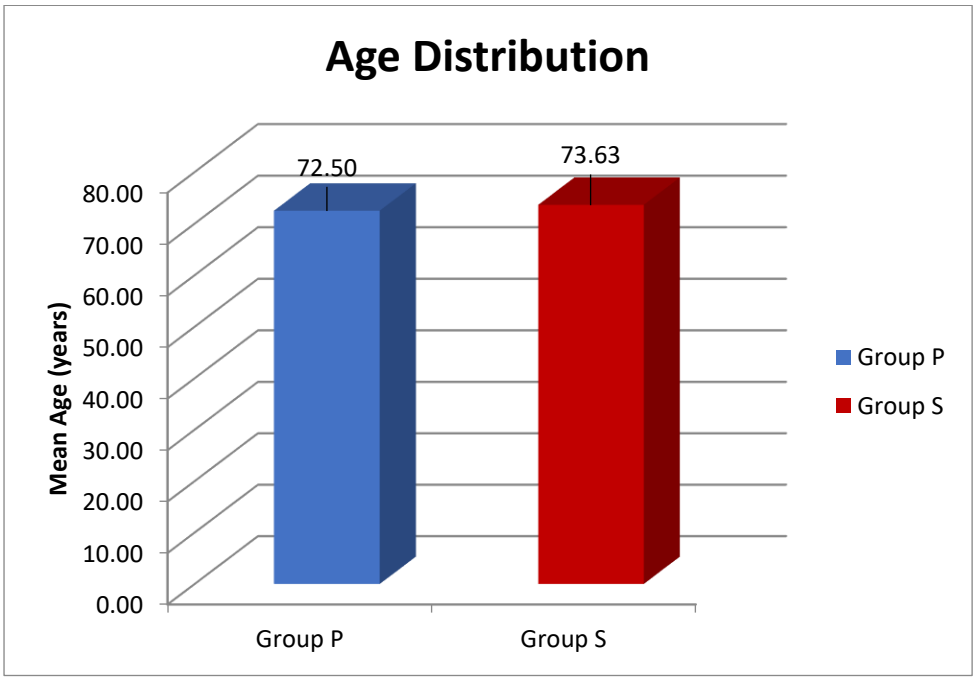

FIGURE 5a: DISTRIBUTION OF SUBJECTS ACCORDING TO MEAN AGE (YEARS)

Mean age of patients in group P was 72.50 ± 8.61 years, whereas, it was 73.63 ± 6.59 years in group S. There was no statistically significant difference in the age distribution among the two groups (p-value >0.05). [Table 1a, Figure 5a]

Table 1b: DISTRIBUTION OF SUBJECTS ACCORDING TO GENDER

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Gender	Female	18	60%	11	36.7%	29	3.270	0.120
	Male	12	40%	19	63.3%	31		
Total		30	100%	30	100%	60		

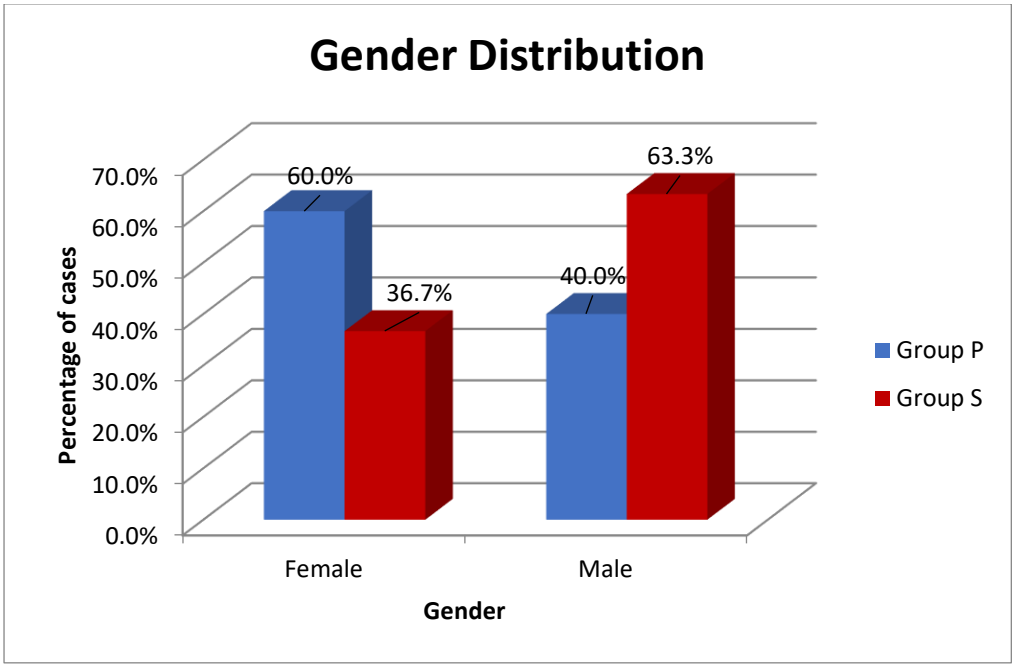

FIGURE 5b: DISTRIBUTION OF SUBJECTS ACCORDING TO GENDER

In group P, 60% of the patients were females and 40% were males whereas, in group S 36.7% were females and 63.3% patients were males. Statistically, there was no significant difference between the groups regarding sex distribution (p-value 0.120). [Table 1b, Figure 5b]

Table 1c: DISTRIBUTION OF SUBJECTS ACCORDING TO WEIGHT, HEIGHT, AND BMI

	Group P		Group S		t	p-value
	Mean	SD	Mean	SD		
Weight (Kg)	70.57	8.96	71.13	12.03	-0.207	0.837
Height (cm)	165.50	7.85	165.60	8.56	-0.049	0.961
BMI	26.43	3.35	25.72	3.18	0.849	0.399

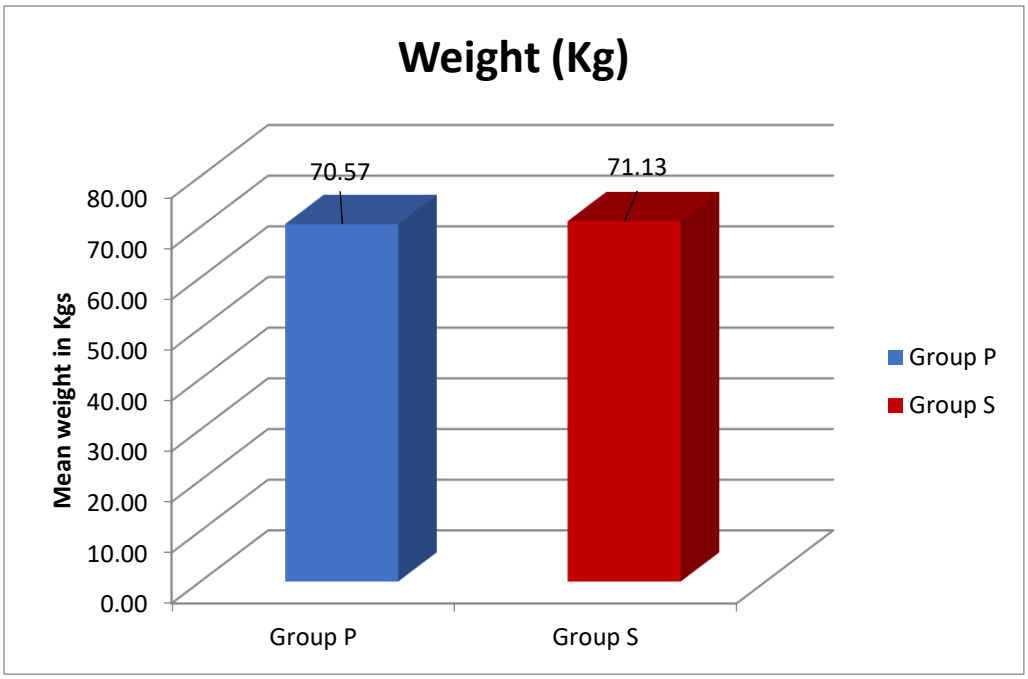

FIGURE 5c: DISTRIBUTION OF SUBJECTS ACCORDING TO MEAN WEIGHT (Kg)

Mean weight of patients was 70.57 ± 8.96 kgs and 71.13 ± 12.03 kgs in group P and S respectively (p-value 0.837). There was no statistically significant difference (p>0.05) of mean weight distribution among patients in both the groups. [Table 1c, Figure 5c]

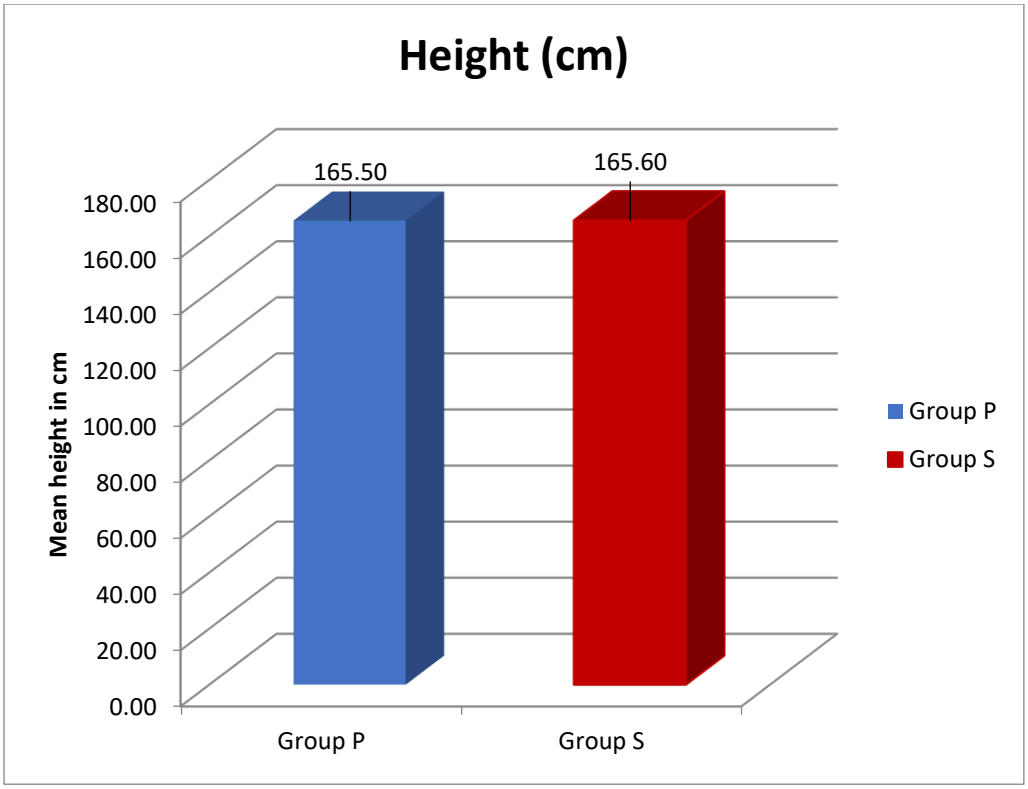

FIGURE 5d: DISTRIBUTION OF SUBJECTS ACCORDING TO MEAN HEIGHT (cm)

Mean height of patients was 165.50 ± 7.85 cm and 165.60 ± 8.56 cm in Group P and group S respectively (p-value 0.961). There was no statistically significant difference (p>0.05) of mean height distribution among patients in both the groups. [Table 1c, Figure 5d]

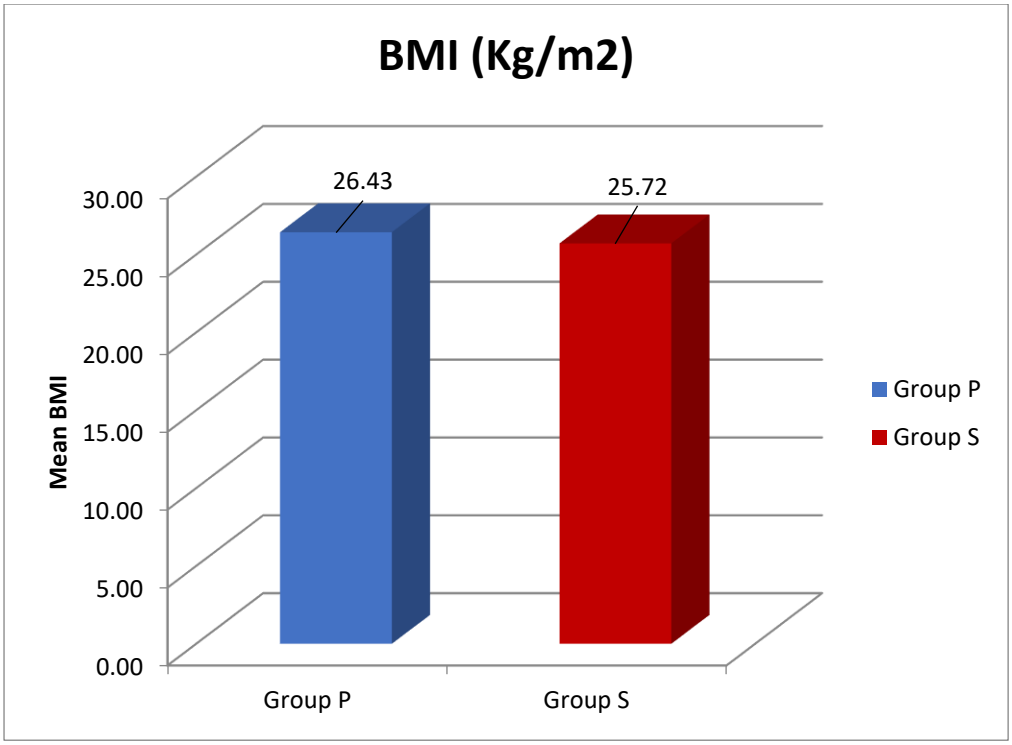

FIGURE 5e: DISTRIBUTION OF SUBJECTS ACCORDING TO MEAN BMI (BASAL METABOLIC INDEX in Kg/m2)

Mean BMI of patients was 26.43 ± 3.35 kg/m2 and 25.72 ± 3.18 kg/m2 in group P and S respectively (p value 0.399). There was no statistically significant difference (p>0.05) of mean BMI distribution among patients in both the groups. [Table 1c, Figure 5e]

TABLE 2: DISTRIBUTION OF SUBJECTS ACCORDING TO ASA GRADE

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
ASA grade	I	0	0.0%	1	3.3%	1	1.355	0.508
	II	7	23.3%	5	16.7%	12		
	III	23	76.7%	24	80.0%	47		
Total		30	100.0%	30	100.0%	60		

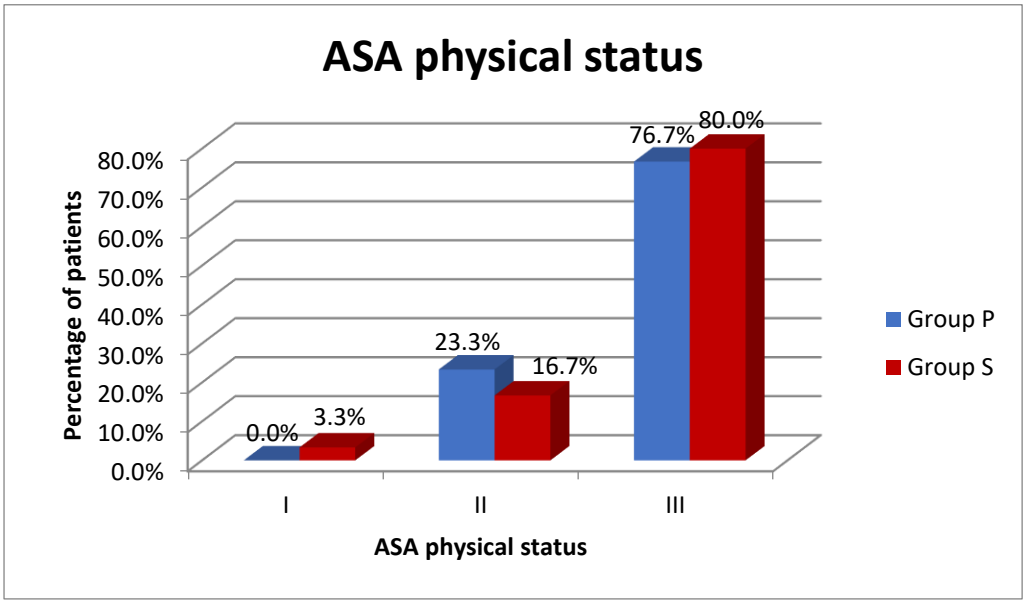

FIGURE 6: DISTRIBUTION OF SUBJECTS ACCORDING TO ASA GRADE

In group P, 23.3% patients belonged to ASA II, and 76.7% belonged to ASA category III. In group S, 3.3% patients belonged to ASA I, 16.7% belonged to ASA II, and 80% patients belonged to ASA category III. Both groups were comparable in terms of ASA grading, with no statistically significant difference ($p>0.05$), although both groups had a higher number of ASA category III patients. [Table 2, Figure 6]

TABLE 3: DISTRIBUTION OF SUBJECTS ACCORDING TO TYPE OF HIP SURGERY

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Type of hip surgery	Hemiarthroplasty	12	40%	11	36.7%	23	3.043	0.551
	Proximal Femur Biopsy with Nailing	0	0%	1	3.3%	1		
	Proximal femur excision with antibiotic spacer insertion	0	0%	1	3.3%	1		
	Proximal femur nailing (PFN)	17	56.7%	17	56.7%	34		
	Screw re-adjustment of PFN	1	3.3%	0	0.0%	1		
Total		30	100%	30	100%	60		

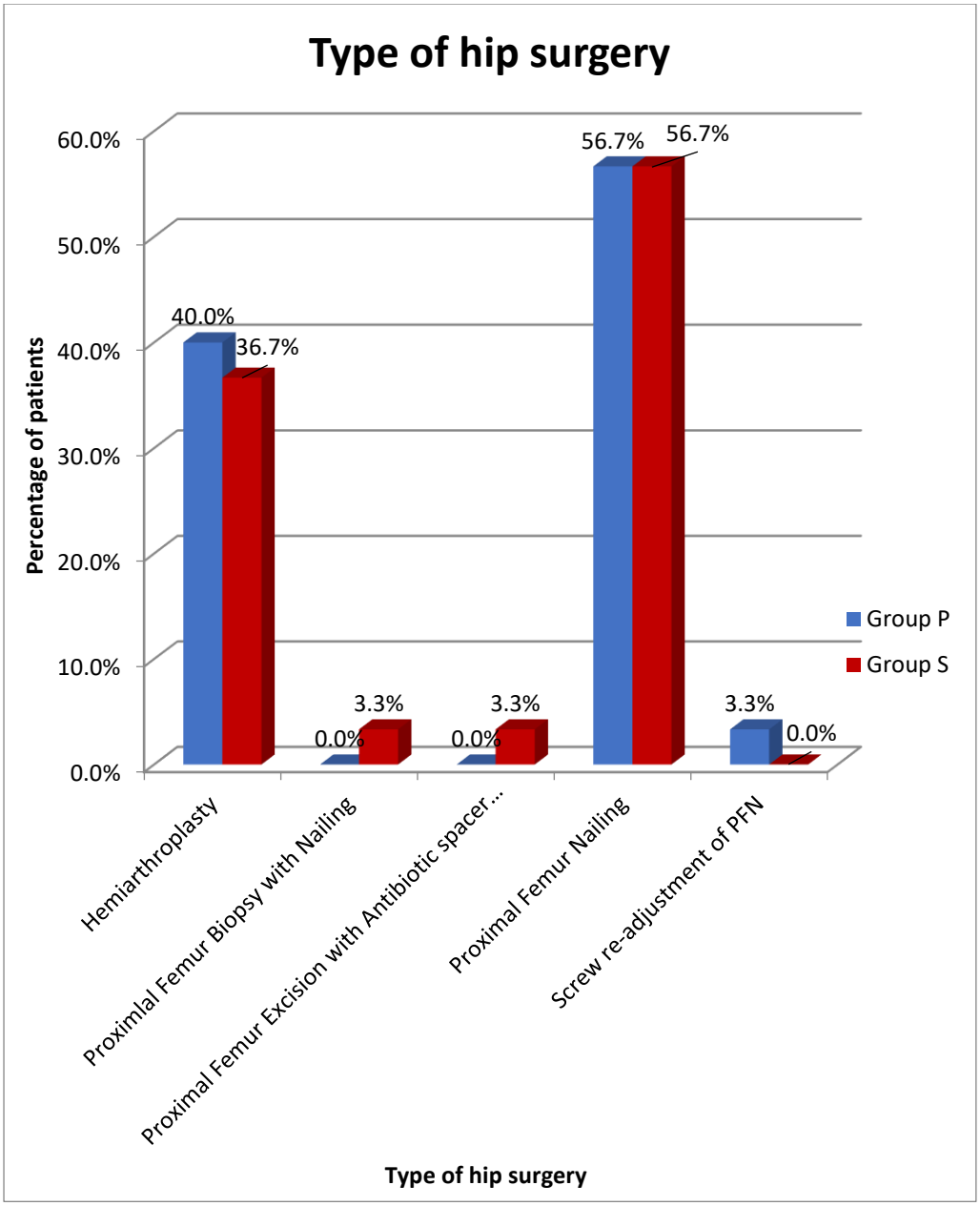

FIGURE 7: DISTRIBUTION OF PATIENTS ACCORDING TO TYPE OF HIP SURGERY

In group P, 56.7%, 40% and 3.3% of subjects underwent Proximal femur nailing (PFN), Hemiarthroplasty, and screw re-adjustment of PFN respectively. In group S, 56.7%, 36.7%, 3.3% and 3.3% of patients underwent Proximal femur nailing, Hemiarthroplasty, Proximal femur biopsy with nailing and Proximal femur excision with antibiotic spacer insertion respectively. This distribution of subjects with respect to the type of surgery was similar in both groups ($p>0.05$). [Table 3, Figure 7]

Table 4: COMPARISON OF STUDY GROUPS ACCORDING TO THE DURATION OF SURGERY (in minutes)

	Group P		Group S		t	p-value
	Mean	SD	Mean	SD		
Duration of surgery in minutes (time from skin incision to closure)	82.83	24.69	79.67	19.78	0.548	0.586

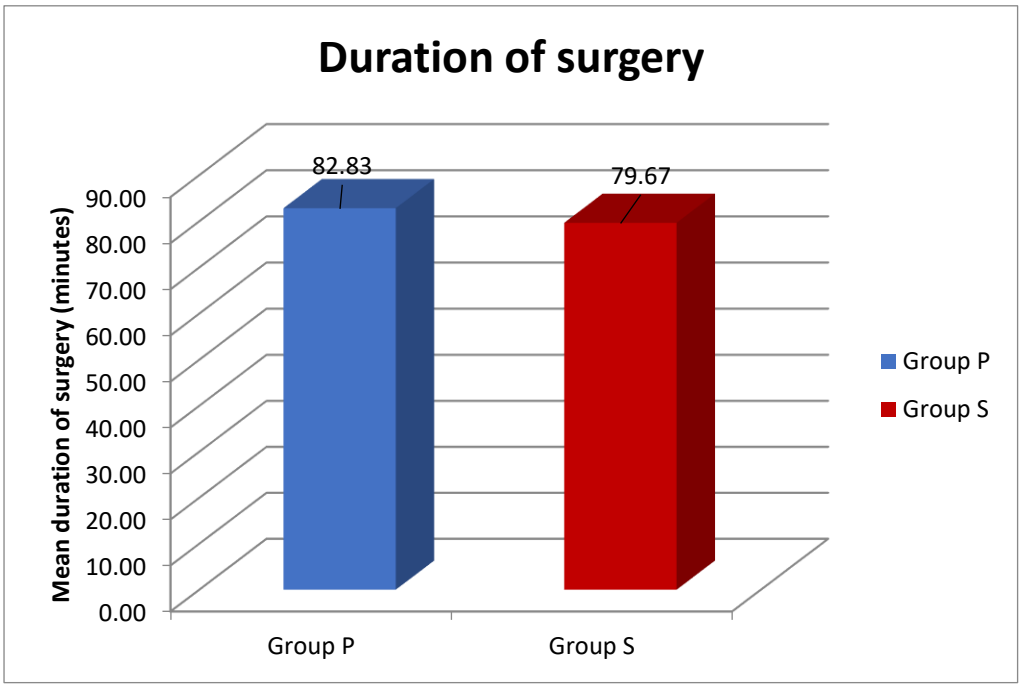

Figure 8: COMPARISON OF STUDY GROUPS ACCORDING TO THE MEAN DURATION OF SURGERY (in minutes)

The mean duration of surgery was defined as the time from skin incision to closure (82.83 ± 24.69 minutes in group P and 79.67 ± 19.78 minutes in group S) which was also found comparable in both the groups (p>0.05). [Table 4, Figure 8]

TABLE 5: DISTRIBUTION OF SUBJECTS ACCORDING TO THE MAXIMUM LEVEL OF SENSORY BLOCKADE ACHIEVED AFTER SPINAL ANAESTHESIA

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Level of sensory blockade	T6	4	13.3%	5	16.7%	9	2.93	0.864
	T7	20	66.7%	18	60.0%	38		
	T8	6	20.0%	7	23.3%	13		
Total		30	100.0%	30	100.0%	60		

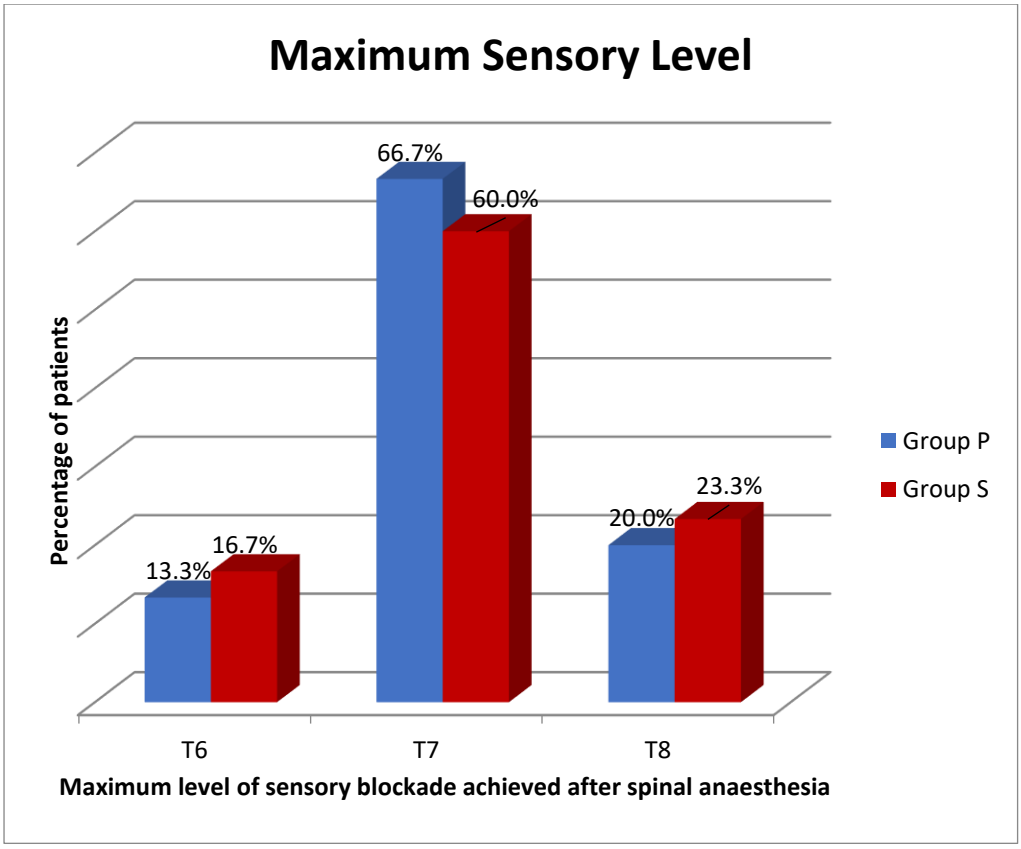

FIGURE 9: DISTRIBUTION OF SUBJECTS ACCORDING TO THE MAXIMUM LEVEL OF SENSORY BLOCKADE ACHIEVED AFTER SPINAL ANAESTHESIA

In both the groups, the level of maximum sensory blockade achieved after spinal anaesthesia was comparable. T 8, T 7 and T 6 level of

sensory blockade were seen in 20%, 66.7% and 13.3% subjects respectively in group P. T 8, T 7 and T 6 level sensory blockade was seen in 23.3%, 60% and 16.7% subjects in group S. Therefore, the highest level of sensory block achieved after spinal anaesthesia was comparable between the two groups with $p>0.05$. [Table 5, Figure 9]

TABLE 6: DISTRIBUTION OF SUBJECTS ACCORDING TO THE MAXIMUM LEVEL OF MOTOR BLOCKADE ACHIEVED AFTER SPINAL ANAESTHESIA (Modified Bromage Grade achieved)

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Max. level of motor blockade (Modified Bromage grade)	1	0	0%	0	0%	0	0.000	1.000
	2	0	0%	0	0%	0		
	3	30	100%	30	100%	60		
Total		30	100%	30	100%	60		

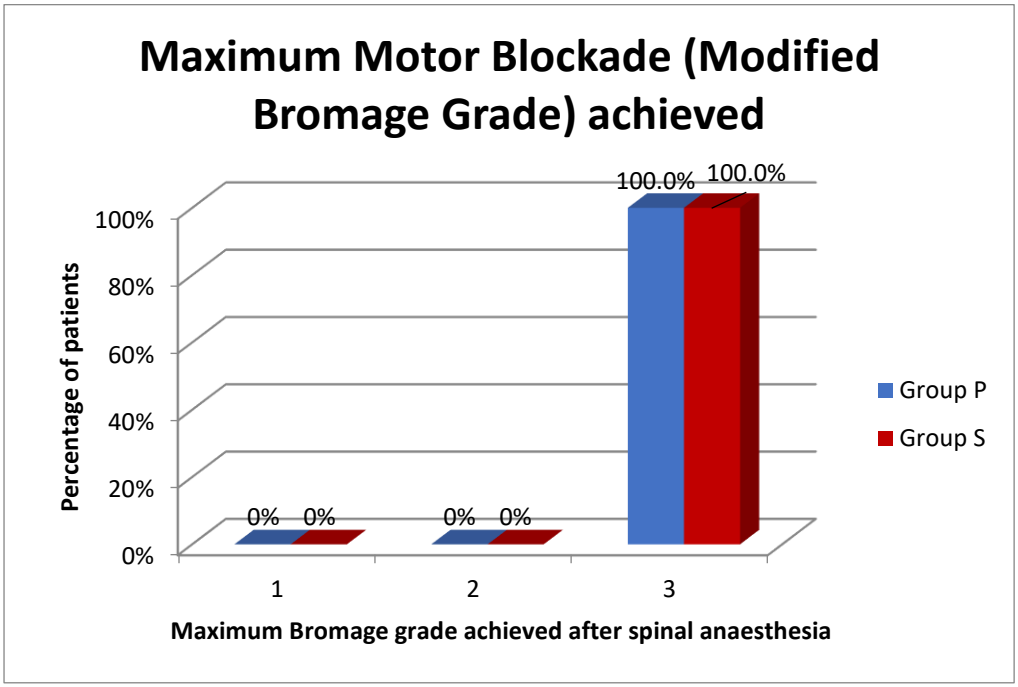

FIGURE 10: DISTRIBUTION OF SUBJECTS ACCORDING TO THE MAXIMUM LEVEL OF MOTOR BLOCKADE ACHIEVED AFTER SPINAL ANAESTHESIA (Modified Bromage Grade achieved)

Maximum level of motor blockade achieved was comparable in both the groups ($p>0.05$) signifying equally efficient spinal blockade. [Table 6, Figure 10]

TABLE 7: TRENDS IN MEAN VAS SCORE AT REST IN 24 HOURS POST-OPERATIVELY

	Group P		Group S		Z	p-value
	Mean	SD	Mean	SD		
Pre-operative VAS score at rest	9.00	1.23	8.63	1.61	-0.794	0.427
VAS score at 0 min (on arrival in PACU)	0.37	1.00	0.13	0.57	-0.895	0.371
VAS score at 1st hr	0.53	1.57	0.13	0.57	-0.909	0.363
VAS score at 2nd hr	0.37	1.10	0.60	1.61	-0.672	0.501
VAS score at 3rd hr	0.57	1.30	1.60	1.90	-2.716	0.007
VAS score at 4th hr	1.00	1.41	2.87	2.33	-3.204	0.001
VAS score at 6th hr	0.87	2.10	3.13	2.30	-4.662	0.001
VAS score at 8th hr	1.37	2.13	1.77	1.59	-1.816	0.069
VAS score at 12th hr	1.17	1.37	2.00	1.97	-1.728	0.084
VAS score at 16th hr	1.27	1.78	2.10	1.27	-2.930	0.003
VAS score at 20th hr	1.00	1.31	2.23	1.14	-3.713	0.001
VAS score at 24th hr	0.87	1.48	2.00	1.72	-2.773	0.006

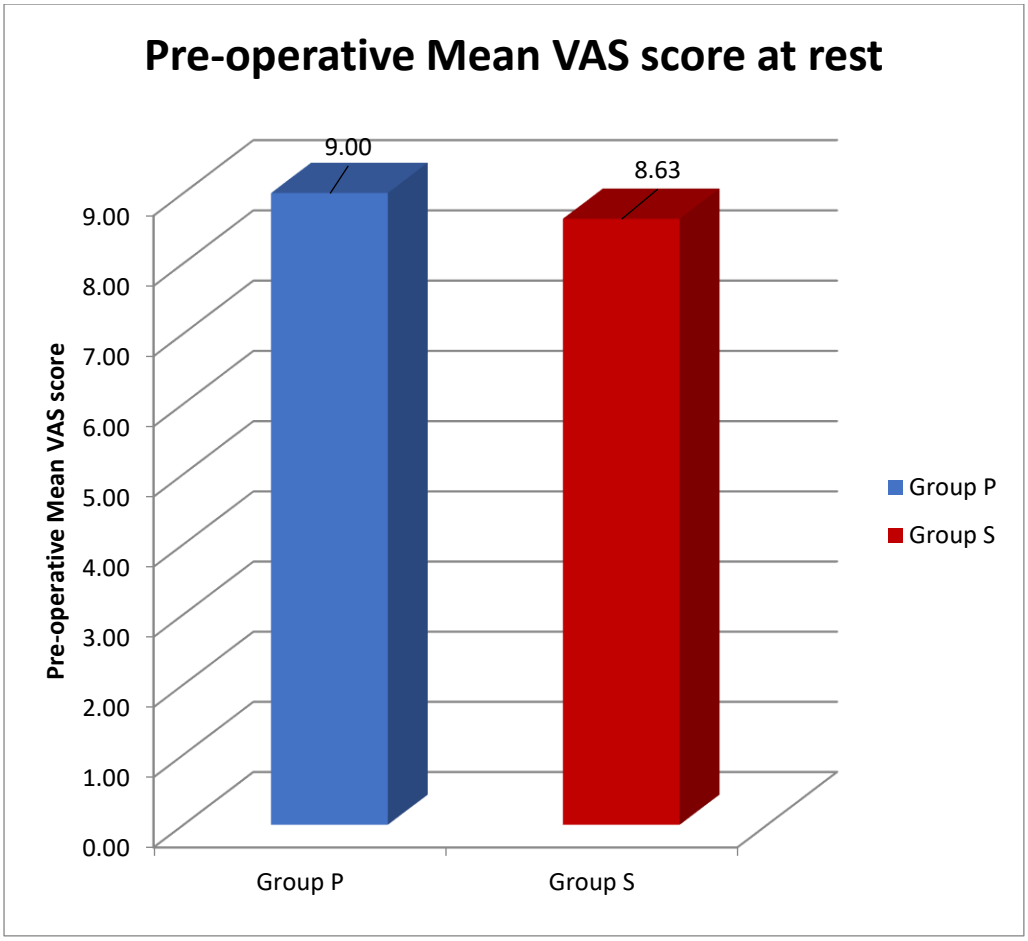

FIGURE 11: PRE-OPERATIVE MEAN VAS SCORE AT REST

Pre-operative VAS scores were comparable in both groups (9.00 ± 1.23 in group P and 8.63 ± 1.61 in group S) with a p-value of 0.427. [Table 7, Figure 11]

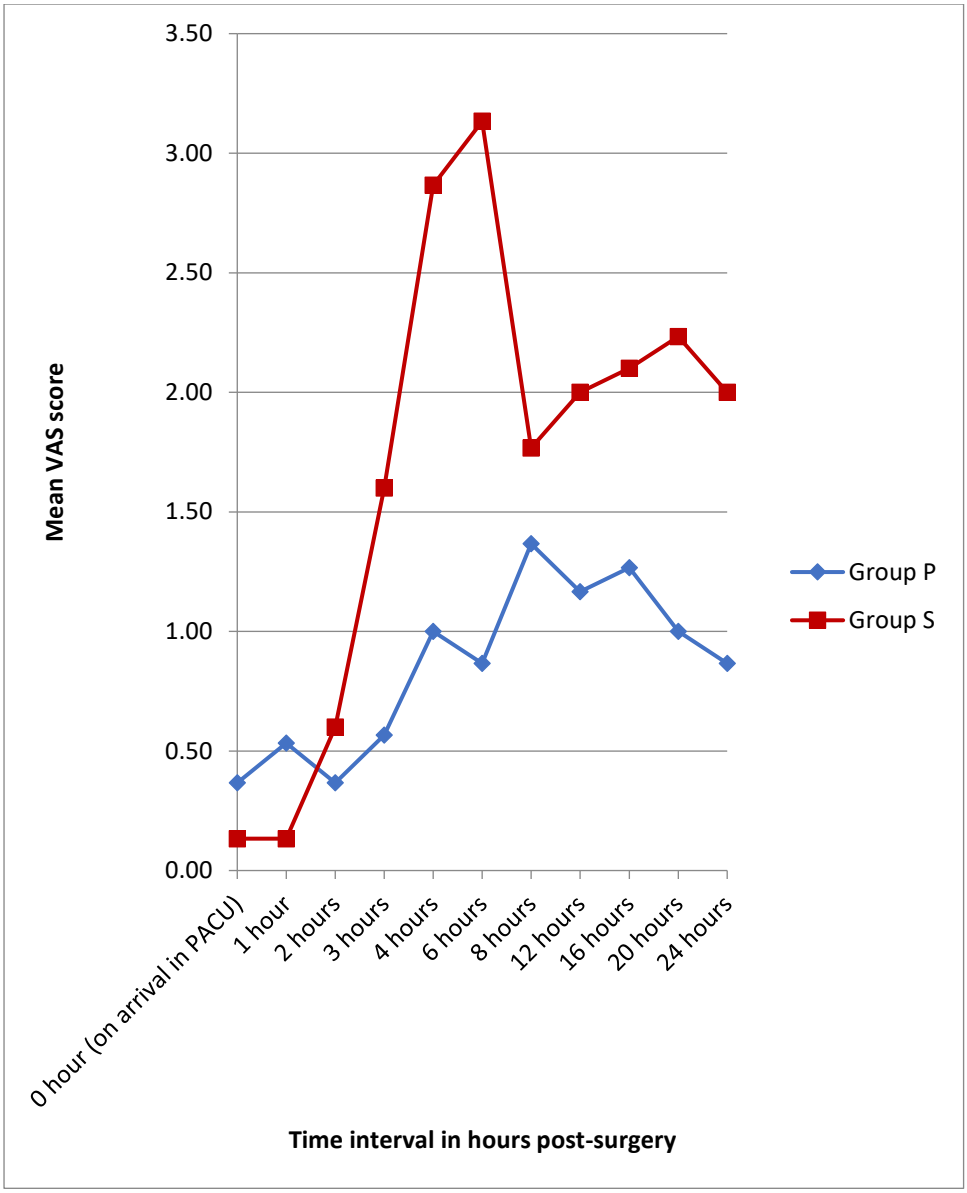

FIGURE 12: TRENDS IN MEAN VAS SCORE IN 24 HOURS POST-OP

The mean VAS scores at rest were significantly lower in group P at 3, 4, 6, 16, 20 and 24 hours postoperatively than group S with p-values of 0.007, 0.001, 0.001, 0.003, 0.001 and 0.006 respectively. [Table 7, Figure 12]

TABLE 8: MEAN VAS SCORE AT 24 HOURS POST-OP AT REST

	Group P		Group S		Z	p-value
	Mean	SD	Mean	SD		
VAS score at 24 hours at rest	0.87	1.48	2.00	1.72	-2.773	0.006

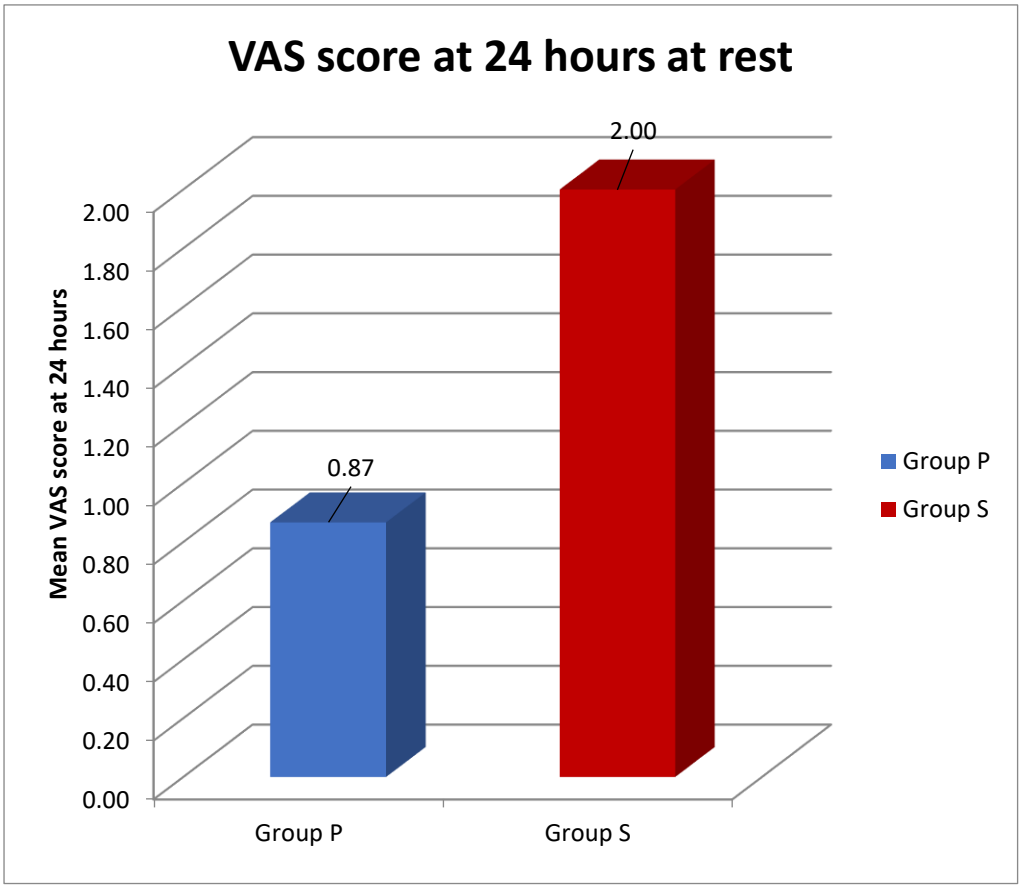

FIGURE 13: MEAN VAS SCORE AT 24 HOURS POST-OP AT REST

The mean VAS scores at 24 hours post-surgery at rest were found to be significantly less in group P (0.87 ± 1.48) than group S (2.00 ± 1.72) with p-value of 0.006. [Table 8, Figure 13]

TABLE 9: MEAN GRADES OF QUADRICEPS MUSCLE STRENGTH AT 24 AND 48 HOURS POST OPERATIVELY BETWEEN THE GROUPS

	Group P		Group S		Z	p-value
	Mean	SD	Mean	SD		
Quadriceps muscle strength grades at 24 hrs	1.60	0.56	1.30	0.53	-2.235	0.025
Quadriceps muscle strength grades at 48 hrs	3.90	0.61	3.37	0.72	-3.093	0.002

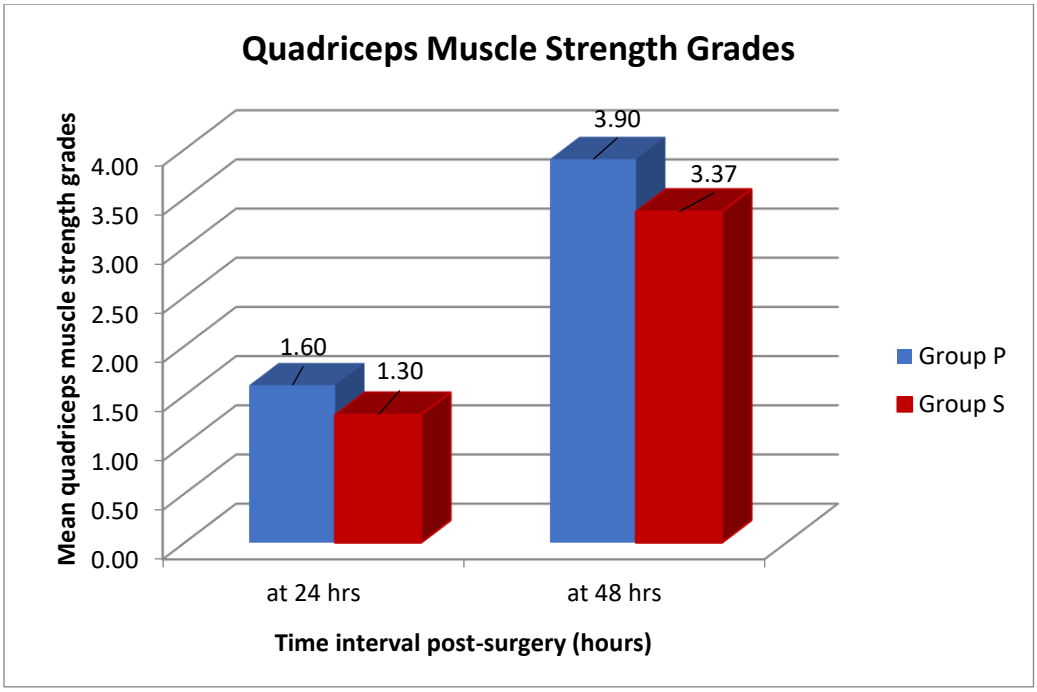

FIGURE 14: MEAN GRADES OF QUADRICEPS MUSCLE STRENGTH AT 24 AND 48 HOURS POST OPERATIVELY BETWEEN THE GROUPS

Mean grades of quadriceps muscle strength in group P are higher and statistically significant both at 24 hours (1.60 ± 0.56) and 48 hours (3.90 ± 0.61) post operatively than group S with p-values of 0.025 and 0.002 respectively. [Table 9, Figure 14]

TABLE 10a: DISTRIBUTION OF SUBJECTS ACCORDING TO THE GRADES OF WEIGHT BEARING (MAXIMUM THE PATIENT WAS ABLE TO PERFORM) AT 24 HOURS POST OPERATIVELY

		Group P		**Group S**		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Weight bearing at 24 hrs	Grade 1 (NWB)	8	26.7%	21	70.0%	29	11.279	0.002
	Grade 2 (TTWB)	22	73.3%	9	30.0%	31		
Total		30	100%	30	100%	60		

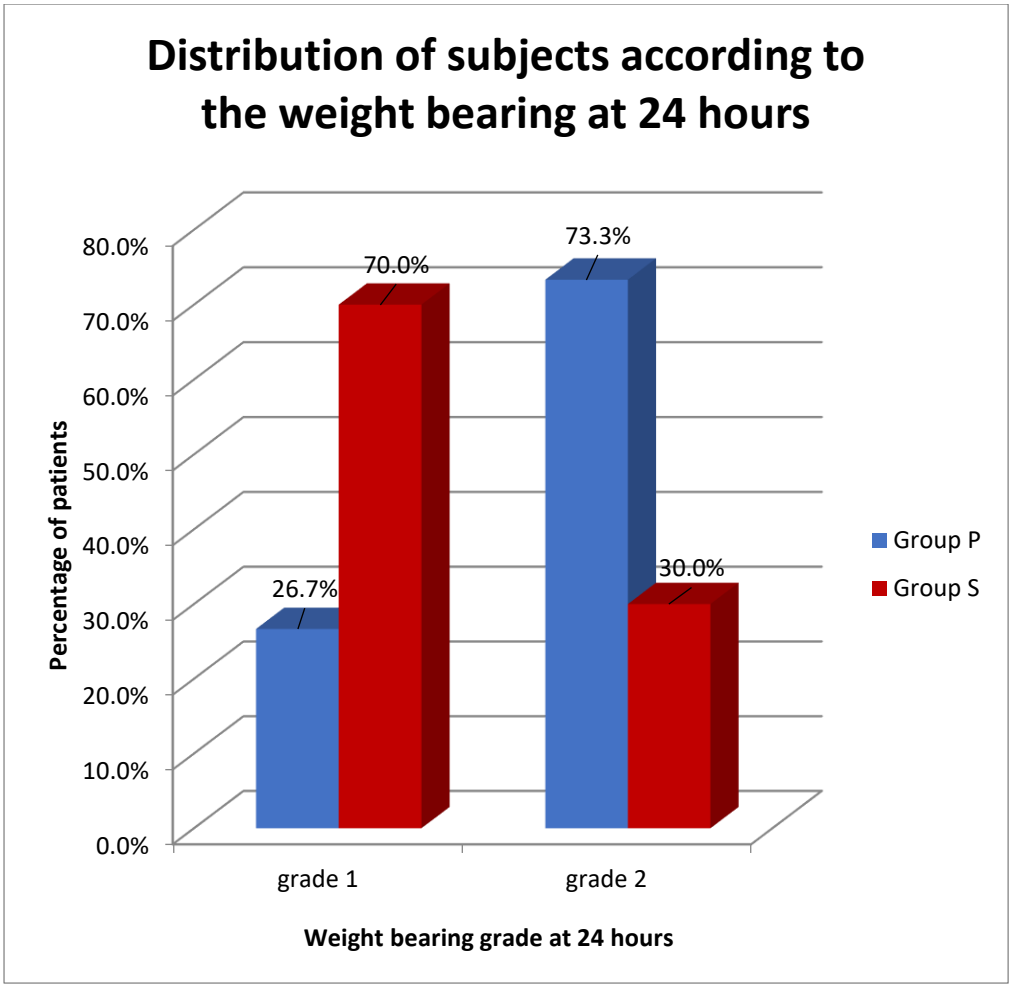

FIGURE 15a: DISTRIBUTION OF SUBJECTS ACCORDING TO THE GRADES OF WEIGHT BEARING (MAXIMUM THE PATIENT WAS ABLE TO PERFORM) AT 24 HOURS POST OPERATIVELY

Only Grade 1- Non-weight bearing (NWB) and Grade 2- Toe-touch weight-bearing (TTWB) was allowed at 24 hours post-surgery whichever maximum the patient was able to perform. More number of patients in group P were able to perform higher grades of weight bearing at 24 hours (73.3% patients) than group S where only 30% of the patients were able to perform grade 2 weight bearing at 24 hours post-surgery (p value 0.002). [Table 10a, Figure 15a]

TABLE 10b: DISTRIBUTION OF SUBJECTS ACCORDING TO THE GRADES OF WEIGHT BEARING (MAXIMUM THE PATIENT WAS ABLE TO PERFORM) AT 48 HOURS POST OPERATIVELY

		Group P		**Group S**		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Weight bearing at 48 hrs	Grade 3	3	10.0%	5	16.7%	8	0.605	0.739
	Grade 4	20	66.7%	18	60.0%	38		
	Grade 5	7	23.3%	7	23.3%	14		
Total		30	100.0%	30	100.0%	60		

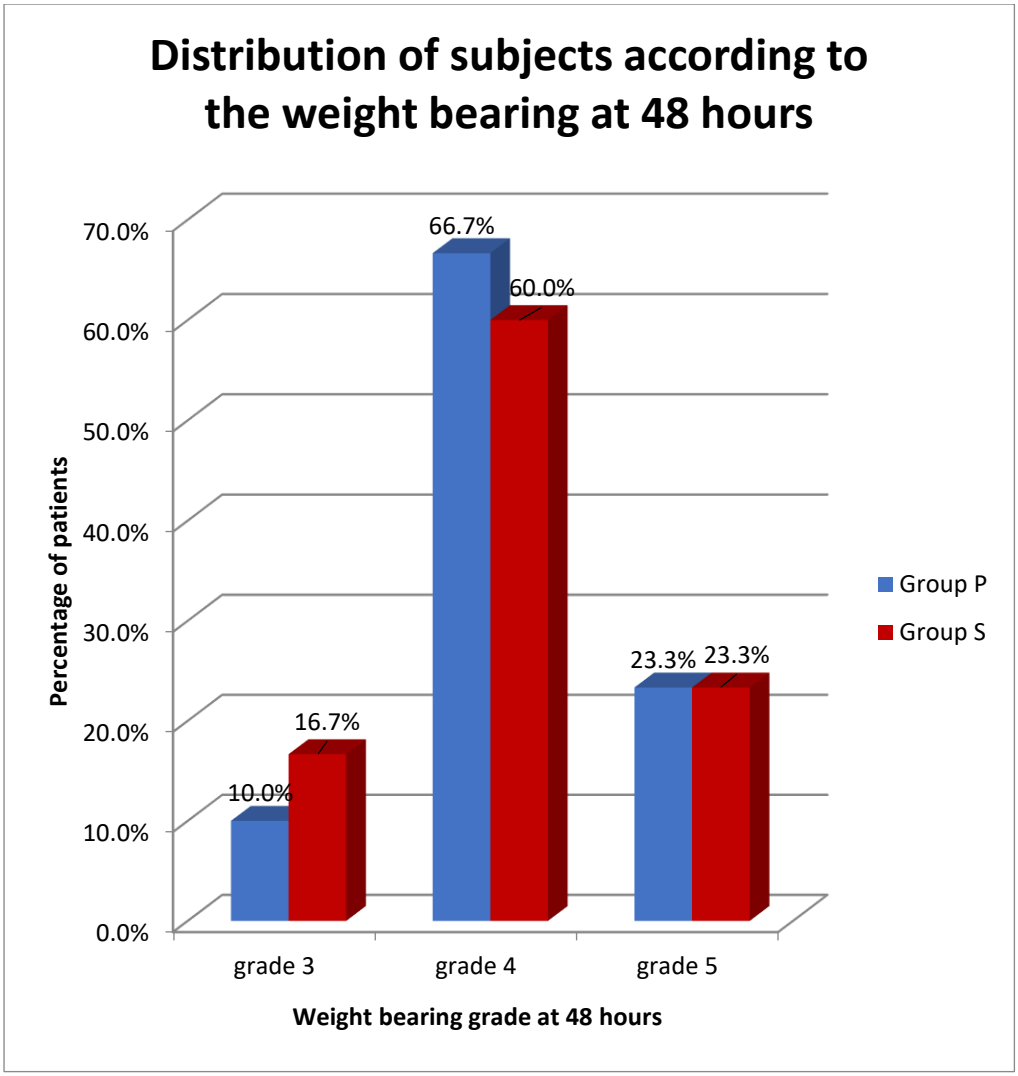

FIGURE 15b: DISTRIBUTION OF SUBJECTS ACCORDING TO THE GRADES OF WEIGHT BEARING (MAXIMUM THE PATIENT WAS ABLE TO PERFORM) AT 48 HOURS POST OPERATIVELY

At 48 hours, grade 3- Partial weight-bearing (PWB), grade 4- Weight bearing as tolerated (WBAT) and grade 5- Full weight-bearing (FWB) was allowed whichever maximum the patient was able to perform. Comparative grades of maximum weight bearing were found statistically insignificant at 48 hours in both groups post operatively (p value 0.739). [Table 10b, Figure 15b]

TABLE 11: TIME TO NEED FOR FIRST RESCUE OPIOID ANALGESIA (in minutes) hence, DETERMINATION OF TOTAL DURATION OF ANALGESIA PROVIDED BY THE BLOCK (in minutes)

	Group P		Group S		Z	p-value
	Mean	SD	Mean	SD		
Total duration of analgesia of block (mins)	678.50	327.55	469.50	182.74	-2.344	0.019

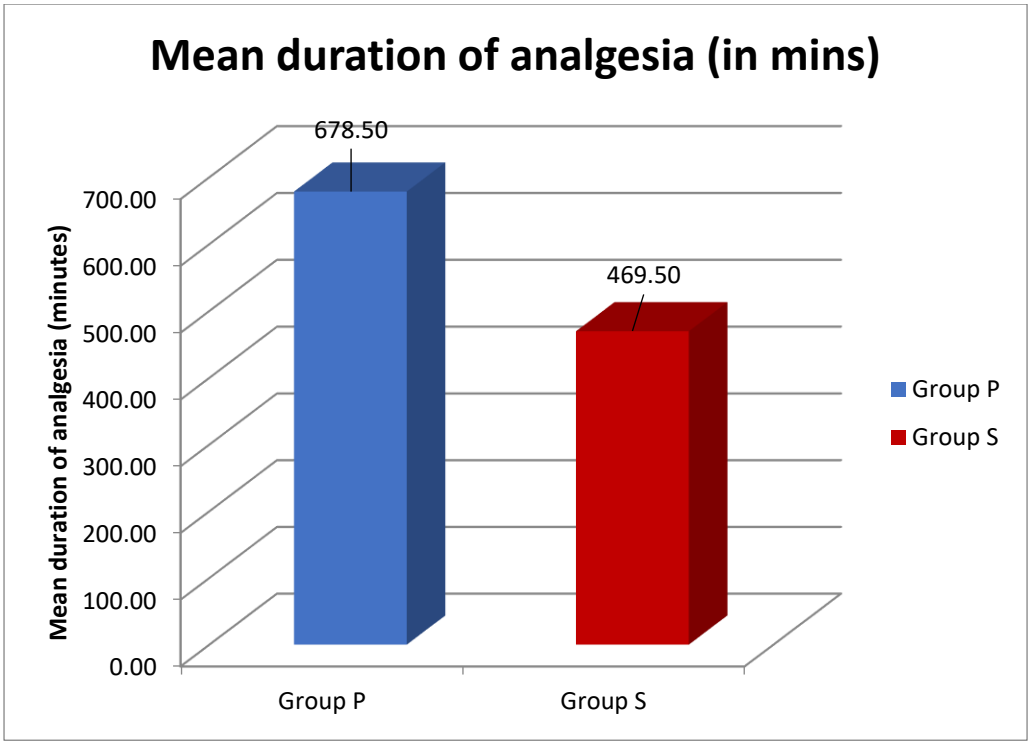

FIGURE 16: MEAN DURATION OF ANALGESIA PROVIDED BY THE BLOCK (in minutes)

Mean duration of analgesia was defined as the time from administering the block to the time of first requirement of rescue opioid analgesic at VAS ≥4. The mean duration of analgesia was 678.50 ± 327.55 minutes in group P and 469.50 ± 182.74 minutes in group S (p-value 0.019). The difference was statistically significant between both groups. [Table 11, Figure 16]

TABLE 12: MEAN OPIOID CONSUMPTION IN 24 HOURS POST SURGERY (in mg)

	Group P		Group S		Z	p-value
	Mean	SD	Mean	SD		
Total amount of opioid analgesic used in 24 hours period (in mg)	100.01	39.40	151.68	40.44	-4.181	0.001

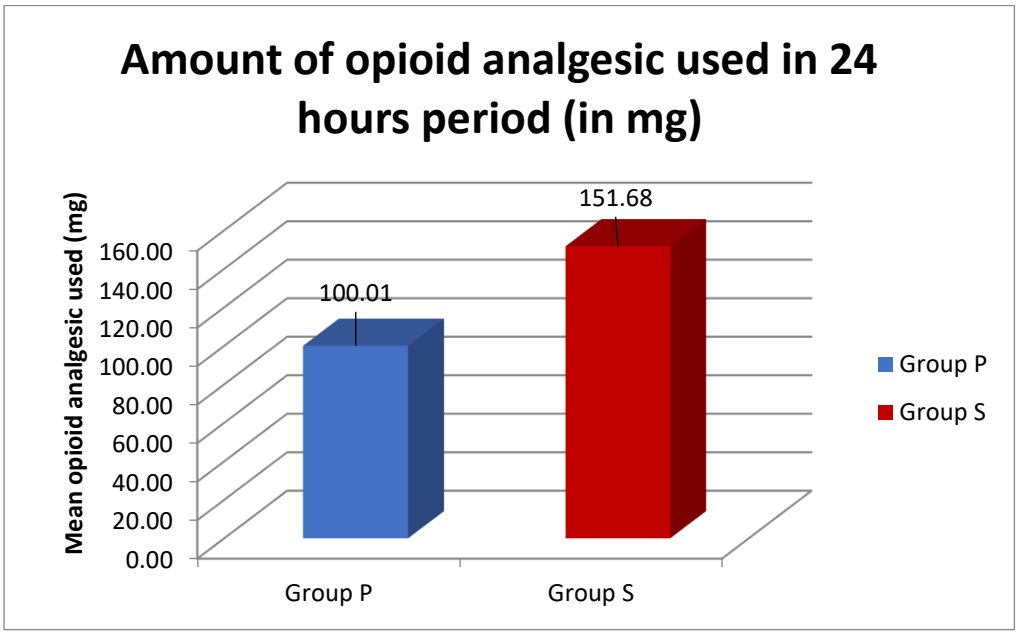

FIGURE 17: MEAN OPIOID CONSUMPTION IN 24 HOURS POST SURGERY (in mg)

Mean total rescue opioid consumption in the 24-hour post-operative period was significantly lower in group P (100.01 ± 39.40 mg) than group S patients (151.68 ± 40.44 mg) with p value of 0.001. [Table 12, Figure 17]

TABLE 13: OVERALL PATIENT SATISFACTION FOR PAIN MANAGEMENT IN FIRST 24 HOURS POST SURGERY (5- point Likert Scale)

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Overall patient satisfaction for pain management (within 24 hours)	dissatisfied	2	6.7%	6	20.0%	8	17.483	0.002
	neither satisfied nor dissatisfied	3	10.0%	14	46.7%	17		
	satisfied	11	36.7%	7	23.3%	18		
	very dissatisfied	2	6.7%	1	3.3%	3		
	very satisfied	12	40.0%	2	6.7%	14		
Total		30	100.0%	30	100.0%	60		

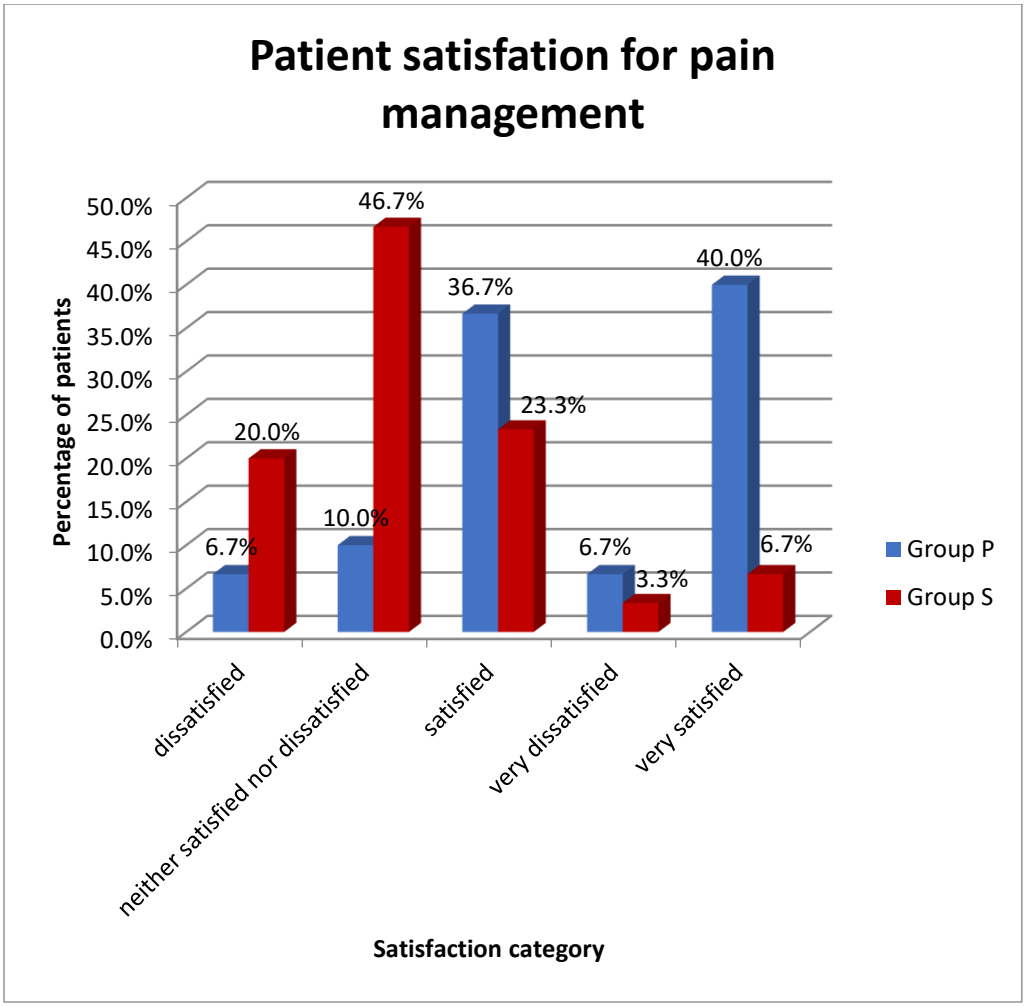

FIGURE 18: OVERALL PATIENT SATISFACTION FOR PAIN MANAGEMENT IN FIRST 24 HOURS POST SURGERY (5- point Likert Scale)

In group P, 36.7% patients were satisfied and 40% patients were very satisfied with the overall pain management in 24 hours and in group S only 23.3% and 6.7% patients were satisfied and very satisfied respectively with 46.7% patients being neither satisfied nor dissatisfied with the overall pain management. Thus, the patient satisfaction was much higher in group P compared to group S (p value 0.002). [Table 13, Figure 18]

TABLE 14: SURGEON'S SATISFACTION WITH ANAESTHESIA SERVICES FOR OVERALL PAIN MANAGEMENT OF THE PATIENT (5- point Likert Scale)

		Group P		Group S		Total	Chi-square value	p-value
		No. of cases	%age	No. of cases	%age			
Surgeon's satisfaction with anaesthesia services for overall pain management	dissatisfied	2	6.7%	6	20.0%	8	10.96	0.012
	neither satisfied nor dissatisfied	4	13.3%	11	36.7%	15		
	satisfied	14	46.7%	11	36.7%	25		
	Very dissatisfied	0	0.0%	0	0.0%	0		
	very satisfied	10	33.3%	2	6.7%	12		
Total		30	100%	30	100.0%	60		

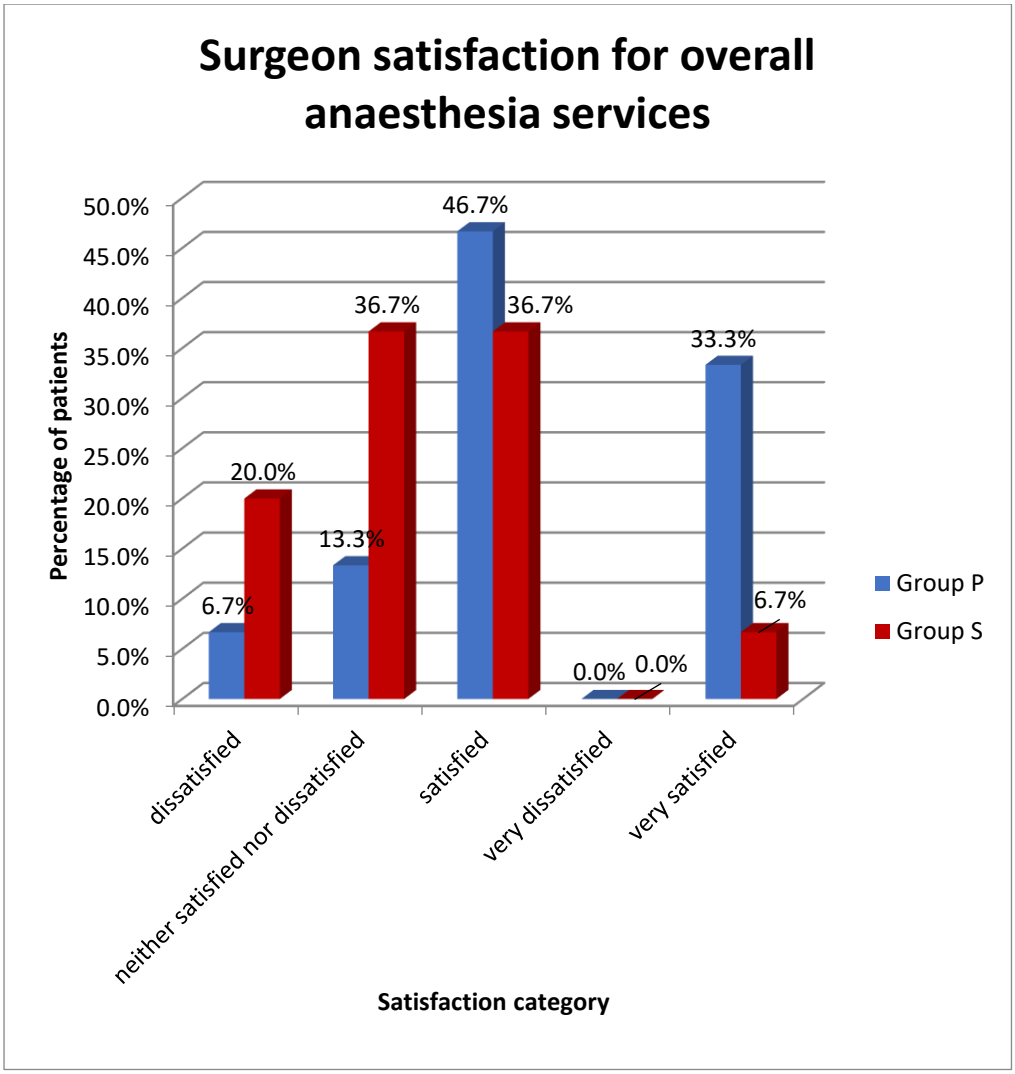

FIGURE 19: SURGEON'S SATISFACTION WITH ANAESTHESIA SERVICES FOR OVERALL PAIN MANAGEMENT OF THE PATIENT (5- point Likert Scale)

In group P, surgeons were more satisfied with the overall pain management of the patients than group S (p value 0.012). [Table 14, Figure 19]

DISCUSSION

Pericapsular nerve group (PENG) block and Fascia iliaca compartment block (FICB) are the two most commonly employed regional techniques to provide peri-operative analgesia in hip surgeries. However, nowadays, achieving maximum pain-free hours after surgery with minimal side effects is not the only goal. According to the “Enhanced Recovery After Surgery (ERAS) protocols”, a good postoperative outcome is considered positive only when it is associated with a shortened length of PACU and hospital stay, along with a better functional outcome in terms of minimal or absent postoperative functional incapacitation, which aids in early ambulation and discharge from the hospital. [12]

Our study aimed to compare the analgesic efficacy of ultrasound-guided Pericapsular nerve group (PENG) block versus Supra-inguinal fascia iliaca (SIFI) block in hip surgeries, along with their functional outcome in terms of motor power after surgery for early recovery of these patients. The effectiveness of these blocks has been demonstrated in various studies, but there is limited data on their motor sparing and blocking abilities to draw definitive conclusions.

In this prospective randomized study, we compared post-operative VAS scores for 24 hours at rest, along with the post-op functional mobility in these patients by assessing quadriceps muscle strength and maximum weight bearing at 24- and 48-hours after surgery in both groups. The duration of analgesia provided by these blocks, total opioid consumption in 24 hours, and patient and surgeon overall satisfaction with pain management in these patients was also compared.

In our study, both groups were statistically similar in terms of their demographic profiles, type and duration of surgery, and level of sensory and motor blockade of anesthesia achieved after subarachnoid block. Pre-operative VAS scores were also comparable in both groups. Hence, the comparable confounders did not have the ability to bias our results.

Pain intensity, as suggested by mean VAS score at 24 hours post-op at rest, was found to be significantly lower in group P compared to group S (0.87 vs 2.00) (p value = 0.006) in our study. The mean VAS scores were significantly lower in group P compared to group S at 3 hours (0.57 vs 1.60), 4 hours (1.00 vs 2.87), 6 hours (0.87 vs 3.13), 16 hours (1.27 vs 2.10) and 20 hours (1.00 vs 2.23) post-operatively, along with 24 hours. The mean duration of analgesia, defined as the time from administering the block to the time for requirement of the first rescue opioid analgesic post-surgery at VAS ≥4, was significantly prolonged in group P (678.50 ± 327.55 minutes) compared to group S (469.50 ± 182.74 minutes) (p value = 0.019) in our study. In addition, the mean total requirement of rescue opioid analgesic in the initial 24 hours post-surgery was significantly lower in group P (100.01 ± 39.40 mg) than in group S patients (151.68 ± 40.44 mg) (p value =0.001).

Our findings imply superior analgesic efficacy of the Pericapsular nerve group (PENG) block over Supra-Inguinal Fascia iliaca (SIFI) block. These findings align with a previously published study by KS Senthil et al., who also observed a median reduction in pain scores at 14, 18, and 24 hours in the PENG group (assessed using VAS scores at 2,6,10,14,18 & 24 hours) compared to the FICB group. [18] The study population was small, and they used 30ml of 0.25% Levobupivacaine with 4 mg dexamethasone for the USG-guided blocks, whereas we used 30ml of 0.2% Ropivacaine along with 4mg dexamethasone.

However, we observed a significant decrease in pain scores between the two groups earlier in our study (at 4 hours), using the same quantity of a different local anaesthetic drug compared to KS Senthil et al. (at 14 hours). [18] This difference could be because we assessed VAS scores hourly for the first 4 hours, 2 hourly for the next 4 hours and then every 4 hours till 24 hours post-surgery in our study compared to every 4 hourly in their study (starting at 2 hours post-surgery), which might have been missed despite the proven greater potency of Levobupivacaine than Ropivacaine in peripheral nerve blocks as seen in a meta-analysis of

RCTs done by Ang Li et al. in 2017. [71] The findings of our study are in concordance with the previously published case reports and retrospective case series by Giron et al. and Morrison C et al. [1,51] Kukreja P et al. in 2022 also observed lower average VAS scores in patients who were administered PENG block undergoing primary THA and reported significantly reduced morphine consumption post-surgery, thus concluding that PENG block can serve as a viable alternative to FNB or lumbar plexus block for primary THA. [50]

For functional outcome, we assessed the extent of motor blockade caused by these blocks by using the manual muscle testing (MMT) scale at 24- and 48-hours post-surgery. We observed that mean values of quadriceps muscle strength grades were significantly higher both at 24 hours (1.60 vs 1.30) and 48 hours (3.90 vs 3.37) postoperatively in group P than group S with p-values of 0.025 and 0.002, respectively. Our results were in agreement with KS Senthil et al. who also assessed quadriceps muscle strength in both groups using muscle power scale (MRC) at 2, 6, 10, 14, 18, and 24 hours and observed a significant difference in motor power at 18 and 24 hours in the PENG group compared to the FICB group. [18]

This could be attributed to the sparing of motor blockade of the quadriceps muscle in group PENG compared to group SIFI, or it may be due to the reduced VAS scores in group P at 24 hours due to its better analgesic efficacy, allowing the patients to perform muscle movements more easily. Again, better muscle power was observed first at 24 hours (later) in our study compared to 18 hours in the above-mentioned study, which could be because we assessed muscle power only at 24 and 48 hours post-surgery in comparison to every 4 hours in the above-mentioned study. [18]

These findings align with the previous study conducted by Huda AU et al. and Duan L et al., which showed enhanced quadriceps strength in patients undergoing THA with PENG block. [72,73] This observation indicates that PENG block could promote early ambulation and recovery

of motor function, potentially decreasing complications like infections and pressure ulcers linked to extended bed rest, underscoring its significant clinical importance.

Indeed, our observations validate the initial observations by Giron et al in 2018 with respect to the analgesic effects of the PENG block and its purported motor-sparing effect described in this study. [1]

We used 0.2% ropivacaine since it results in a lower incidence of motor blockade secondary to a greater degree of motor sensory differentiation, thereby further supporting early mobilization and safety in the post-operative period as used by Kuthiala G et al., thereby, mitigating the potential for motor blockade that could occur from the use of higher concentrations of the local anaesthetic itself. [74]

Since the ideal volume of local anaesthetic for the PENG block remains undetermined, cadaveric studies by Tran and Ciftci indicated that 20 ml of dye effectively dispersed within the anterior capsule of the hip joint, whereas 30 ml volume extended to the iliopsoas, vastus intermedius, and gluteus medius muscles, and near the femoral nerve, potentially impacting quadriceps muscle strength. [75,76] Thus, in this study, we opted to administer 30 ml of 0.2% ropivacaine for PENG and SIFI blocks to investigate potential motor blockade effects that could happen with these blocks. However, this incrementation in dose to 30 ml may also extend the duration of analgesia compared to a volume of 20ml.

To support our assessment of quadriceps muscle strength, we also compared weight bearing in both the groups at 24- and 48-hours post-surgery by using weight-bearing grades, which can be considered as indirect indicator of the motor sparing and blocking effect of the blocks. We only allowed non-weight bearing (NWB) and toe-touch weight-bearing (TTWB) at 24 hours post-surgery, whichever maximum the patient was able to perform according to our hospital practices by most surgeons to avoid post-operative falls and injuries. However, at 48 hours, Partial weight-bearing (PWB), Weight-bearing as tolerated

(WBAT), and Full weight-bearing (FWB) were allowed whichever maximum the patient was able to perform. [69]

Mean grades of weight bearing were found to be statistically significant in the PENG group at 24 hours compared to the SIFI group with a p value of 0.002. This finding correlates with the better quadriceps muscle strength observed at 24 hours in group PENG compared to group SIFI. This can be ascribed to the motor-sparing effect of the PENG block, or it could also be due to the better analgesic efficacy of the PENG block compared to SIFI, as evidenced by the reduced VAS scores seen at 24 hours, which allowed patients to perform more weight-bearing at 24 hours. However, the scores were found to be statistically insignificant at 48 hours postoperatively, possibly owing to the duration of analgesia (usually up to 24 hours) provided by these blocks.

To the best of our knowledge, weight-bearing has never been employed before as a measure of assessment of quadriceps muscle strength and motor involvement by these blocks. This was a key highlight of our study. However, further studies are required to evaluate and provide more definitive evidence on this matter. Therefore, we suggest further researchers to study the amount of maximum weight-bearing possible in these patients after these blocks.

A study by Aliste J et al. found that compared with supra-inguinal FICB, the PENG block resulted in a lower incidence of quadriceps motor block and a decreased incidence of paresis/paralysis of hip adduction at 3 and 6 hours. [77] Similarly, Lin D et al. reported significantly better-maintained quadriceps strength on postoperative day 0 and day 1 in the PENG group compared to the FNB group. [78] Better preserved quadriceps strength permits early ambulation, likely leading to faster recovery and a reduced length of hospital stay, thereby aiding in fast-tracking hip surgery patients.

Both the above studies caution about the possibility of some residual impairment in quadriceps muscle strength following the PENG block,

which could be attributed to either a large volume of local anaesthetic used, a higher concentration of local anaesthetic used (20ml of 0.75% ropivacaine by Lin D et al.), or secondary to the residual effect of spinal anaesthesia used as a primary anaesthesia technique in some studies.[77,78]

YS Choi et al. in 2022 published a study where they found similar analgesic efficacy in PENG vs. SIFI groups in linear mixed model analysis during 48 hours postoperatively and found no difference in quadriceps muscle strength between the patients receiving these blocks for THA under general anaesthesia. Cumulative opioid consumption up to 48 hours postoperative was also similar in the two groups. [62]

Lin D et al. and Aliste J et al. reported no intergroup differences in opioid consumption up to the 24–48hour post-operative period. [77,78] However, the findings of our study elicited a statistically significant decrease in mean total rescue opioid analgesic consumption in the 24-hour post-operative period in PENG group patients. These differences in the results for opiate consumption could be ascribed to the use of higher volumes and concentrations of local anaesthetic solutions (20ml of 0.75% ropivacaine and 20ml of 0.5% levobupivacaine, respectively) used in their studies, in contrast to ours and the alternative comparator blocks (like FNB) used in the study by Lin D et al. [77,78] Perhaps, this suggests that 30ml of 0.2% ropivacaine used in our study might be insufficient, requiring higher doses of rescue analgesics.

During the course of our study, a few additional randomized controlled trials have been published, among which Vamshi C et al. in 2023 showed reduced pain scores and better analgesic efficacy of the PENG block with reduced perioperative morphine consumption compared to SIFI and found quadriceps weakness in the SIFI group. [79] Another study by Duan L et al. in 2023 compared continuous PENG and FICB blocks for THAs and found similar findings along with the demonstration of enhanced quadriceps strength in the PENG group compared to FICB.[73] Furthermore, a systematic review and meta-analysis by Ying H et al. has

been published, which reported that data on the motor-sparing ability of the PENG block is scarce to draw conclusions. [80]

We used a 5-point Likert Scale to assess patient satisfaction and surgeon satisfaction scores for pain relief. Both satisfaction scores were notably higher in group P compared to group S in our study. Lin D et al. also found patient satisfaction scores significantly higher (97%) in the PENG group compared to the FNB group. [78]

There were several limitations in our study that are worth mentioning and could be assessed by future studies. Firstly, various types of surgeries were performed by different surgeons, leading to variation in surgical approach, tissue handling, and operative time which could have influenced the intensity of pain amongst our subjects. Secondly, the anaesthesiologist administering the blocks could not be blinded; however, we tried to overcome this drawback by blinding the person collecting and monitoring the data (recording the VAS scores and other measurements) postoperatively. Another limitation was that all patients received spinal anaesthesia, which may have influenced the results as a confounding factor (especially in the first few hours post-surgery), leading to variability in post-operative analgesic requirements. For this purpose, patients enrolled in this study, shared similar demographic characteristics and a standard dose of 14 to 16 mg Bupivacaine was used with a fixed dose of 25 microgram Fentanyl, which resulted in comparable sensory and motor blockade in both groups.

Moreover, pain resulting from skin incisions during hip surgeries can be diminished by blocking the lateral femoral cutaneous nerve (LFCN). Adding this nerve block to the PENG block might have offered a more painless perioperative sojourn for patients undergoing hip surgeries and might have reduced pain scores even more, which needs further study.[81]

Notwithstanding these limitations, our study design offered a few advantages over other studies: All the blocks were administered with

smaller volumes of local anaesthetic using USG guidance, resulting in higher success rates regarding accuracy of application and hence better analgesic efficacy. All observations in our study were conducted by a single observer to eliminate inter-observer variability, and all the blocks were administered to the subjects by a single experienced consultant anaesthesiologist. We also assessed functional outcomes by evaluating the motor strength of the quadriceps muscle and the maximum weight-bearing possible at 24- and 48-hours post-surgery. Thus, both the sensory and motor aspects of these blocks were compared in a single study.

Therefore, based on our study results, we conclude that the PENG block exhibits superior analgesic and functional efficacy compared to the SIFI block. This is evidenced by lower mean VAS scores seen in the PENG group at 24 hours post-surgery at rest along with significantly greater quadriceps muscle strength at 24 and 48 hours, improved weight-bearing capacity at 24 hours, extended duration of analgesia, reduced 24-hour total rescue opioid consumption, and enhanced satisfaction scores in patients undergoing hip surgeries than the SIFI group.

SUMMARY AND CONCLUSION

The present study was conducted in the Department of Anaesthesiology, Dayanand Medical College and Hospital, Ludhiana after getting approval from the Institutional Ethical Committee. The aim was to compare the efficacy of Pericapsular Nerve Group (PENG) block with that of Supra-inguinal Fascia iliaca (SIFI) block for postoperative analgesia along with post-op functional outcome in patients undergoing hip surgeries.

Sixty patients belonging to ASA grade I, II or III scheduled for orthopaedic hip surgeries under SAB were included in a randomized, double-blind manner after obtaining a written informed consent. Patients were randomly allocated using computer generated random numbers to either of the two groups to receive:

GROUP P

Comprising of 30 patients who received ultrasound-guided Pericapsular Nerve Group (PENG) block with local anaesthetic solution of 30 mL of 0.2% ropivacaine with 4 mg dexamethasone.

GROUP S

Comprising of 30 patients who received ultrasound-guided Supra-inguinal Fascia iliaca (SIFI) block with local anaesthetic solution of 30 mL of 0.2% ropivacaine with 4 mg dexamethasone.

The block was performed by experienced anaesthesiologist after administration of spinal anaesthesia.

After administration of the blocks, patients were evaluated for post-operative pain relief and functional mobility following hip surgeries. This was evaluated by comparative assessment of VAS scores over a 24-hour period post-surgery, time to need for first rescue opioid analgesic, consumption of total amount of opioids in 24-hour period, patient and surgeon satisfaction to pain management using 5-point Likert scale. Functional mobility was assessed by comparing quadriceps muscle

strength grades and maximum weight bearing possible at 24- and 48-hours post-operatively. Results were analysed statistically.

We observed that

1) Pain intensity, as suggested by mean VAS scores, was significantly lower at 24 hours at rest in group P than group S (0.87 vs 2.00) (p value = 0.006) post-operatively.
2) Mean time to need for first rescue opioid analgesic at NRS ≥4 was significantly prolonged in group P (678.50 minutes) than in group S (469.50 minutes) in our study. (p = 0.019)
3) Mean opioid consumption was significantly less in group P than group S (100.01mg vs 151.68mg) (p value = 0.001).
4) Better patient and surgeon satisfaction scores to pain management in group P than group S (P values 0.002 and 0.012 respectively).
5) Mean quadriceps muscle strength grades were significantly higher in group P than group S both at 24 hours (1.60 vs 1.30 with p value = 0.025) and at 48 hours (3.90 vs 3.37 with p value = 0.002) post-operatively.
6) More patients in group P achieved higher grades of weight bearing than group S at 24 hours post-surgery (p value = 0.002).

Hence, from the results of our study, we conclude that Pericapsular Nerve Group (PENG) block is more effective than the Supra-inguinal Fascia iliaca (SIFI) block for post-operative analgesia in hip surgeries and demonstrates a significant motor sparing effect that contributes to improved functional outcomes in patients.

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S. No.	Randomization	Initials	MRD No.	Age (years)	Gender	Height (cm)	Weight (Kg)	BMI	Type of hip surgery	ASA grade	Time of sub-arachnoid block	Level of sensory blockade	Level of motor blockade (Modified Bromage scale)	Time of institution of PENG/ SIFI Block	Duration of surgery in minutes (time from skin incision to closure)	Sensory level at 0 mins (initiation of block)	Sensory level at 30 mins	Sensory level at 1 hr	Sensory level at 1.5 hr	Sensory level at 2 hr	Sensory level at 2.5 hr	Sensory level at 3 hr
1	P	MS	1383308	71	M	176.8	85	28.5	PROXIMAL FEMUR NAILING	3	12:10 PM	T7	3	12:30 PM	80	T7	T8	T10	T12	T12		
2	S	HS	1385954	70	M	167.6	65	23.8	HEMIARTHROPLASTY	3	11:15 AM	T7	3	11:40 AM	95	T7	T9	T10	T12	L1	L1	
3	P	B	1392678	74	F	158.5	85	34.3	PROXIMAL FEMUR NAILING	3	8:30 AM	T7	3	8:40 AM	100	T7	T8	T9	T10	T11	T12	
4	S	AS	1391196	85	M	173.7	80	27.6	PROXIMAL FEMUR NAILING	2	11:30 AM	T8	3	11:45 AM	90	T8	T9	T11	T12	T12	T12	
5	S	SL	1394202	78	F	152.4	50	21.5	PROXIMAL FEMUR NAILING	3	1:40 PM	T8	3	1:50 PM	80	T8	T9	T10	T11			
6	P	SK	1396542	58	F	158.5	70	28.2	HEMIARTHROPLASTY	3	9:00 AM	T7	3	9:15 AM	120	T7	T9	T11	T12	L1	L1	
7	P	DR	1399066	68	F	161.5	88	34.4	PROXIMAL FEMUR NAILING	3	1:20 PM	T8	3	1:40 PM	60	T8	T9	T10	T12	L1		
8	P	YD	1233700	79	F	158.5	65	26.2	PROXIMAL FEMUR NAILING	3	9:30 AM	T8	3	9:30 AM	75	T8	T9	T10	T11	T12		
9	S	GSJ	1393519	80	M	167.6	85	31.2	PROXIMAL FEMUR NAILING	3	10:30 AM	T8	3	10:40 AM	75	T8	T8	T10	T10	T10		
10	S	JS	1395851	75	M	155.4	80	25.3	HEMIARTHROPLASTY	3	1:40 PM	T7	3	1:50 PM	90	T7	T8	T10	T12	L1		
11	P	GK	1417728	62	F	158.5	68	27.4	HEMIARTHROPLASTY	2	10:20 AM	T7	3	10:30 AM	100	T7	T8	T10	T11	T12		
12	S	GS	278089	65	M	176.8	70	23.5	PROXIMAL FEMUR NAILING	2	1:10 PM	T7	3	1:20 PM	50	T7	T9	T11	T12			
13	P	KK	1427077	73	F	161.5	68	26.6	PROXIMAL FEMUR NAILING	3	2:10 PM	T8	3	2:25 PM	70	T8	T9	T10	T12			
14	S	DS	1298161	75	M	161.5	55	21.5	PROXIMAL FEMUR EXCISION AND ANTIBIOTIC SPACER INSERTION	3	10:00 AM	T8	3	10:15 AM	80	T8	T9	T10	T12	T12		
15	S	TK	1416386	80	M	173.7	72	24.9	PROXIMAL FEMUR NAILING	3	9:10 AM	T7	3	9:20 AM	120	T7	T9	T10	T12	L1	L2	
16	S	PS	1416696	85	M	182.9	105	31.4	PROXIMAL FEMUR BIOPSY AND NAILING	3	12:00 PM	T6	3	12:15 PM	75	T6	T8	T9	T10	T12		
17	S	KCG	217507	84	M	167.6	68	24.9	PROXIMAL FEMUR NAILING	3	12:15 PM	T7	3	12:30 PM	70	T7	T8	T10	T10	T12		
18	S	SK	1415130	60	F	155.4	63	26.2	PROXIMAL FEMUR NAILING	3	1:10 PM	T8	3	1:20 PM	105	T8	T9	T10	T10	T12	L1	
19	P	HK	1428497	85	F	161.5	60	23.4	PROXIMAL FEMUR NAILING	3	12:40 PM	T7	3	12:50 PM	130	T7	T8	T10	T10	T12	T12	L1
20	P	BS	1438022	76	M	167.6	78	28.6	HEMIARTHROPLASTY	3	1:00 PM	T7	3	1:15 PM	65	T7	T9	T11	T12	T12		
21	S	GK	1417663	72	F	164.6	70	26.5	HEMIARTHROPLASTY	1	12:40 PM	T8	3	12:50 PM	65	T8	T10	T12	T12			
22	P	RR	1441626	76	F	161.5	65	25.4	HEMIARTHROPLASTY	2	12:30 PM	T8	3	12:45 PM	60	T8	T9	T10	T12			
23	S	US	1419916	74	M	176.8	75	25.1	PROXIMAL FEMUR NAILING	3	11:10 AM	T7	3	11:20 AM	60	T7	T8	T10	T11	T12		
24	S	UD	1430343	70	F	158.5	70	28.2	PROXIMAL FEMUR NAILING	3	9:15 AM	T7	3	9:25 AM	60	T7	T9	T10	T11			
25	S	KK	432447	74	M	170.7	76	27	HEMIARTHROPLASTY	3	11:20 AM	T7	3	11:40 AM	90	T7	T8	T10	T11	T12	L1	
26	P	NRS	1444584	84	M	173.7	58	20	PROXIMAL FEMUR NAILING	2	9:40 AM	T7	3	9:55 AM	120	T7	T8	T9	T10	T11	T12	T12
27	S	SS	239342	70	F	158.5	72	29	PROXIMAL FEMUR NAILING	3	12:50 PM	T7	3	1:00 PM	90	T7	T8	T10	T10	T12	T12	
28	P	GKG	1445106	78	F	164.6	62	23.5	PROXIMAL FEMUR NAILING	2	9:40 AM	T7	3	9:55 AM	75	T7	T9	T10	T12	T12		
29	S	HK	1438806	62	M	161.5	72	28.1	PROXIMAL FEMUR NAILING	2	9:25 AM	T6	3	9:40 AM	130	T6	T7	T9	T10	T12	T12	L1
30	P	GK	1470377	84	F	161.5	70	27.3	PROXIMAL FEMUR NAILING	2	1:10 PM	T7	3	1:30 PM	75	T7	T8	T9	T10	T12		
31	P	KS	233839	73	F	152.4	58	24.8	PROXIMAL FEMUR NAILING	3	11:10 AM	T7	3	11:30 AM	60	T7	T8	T10	T11			
32	P	S	1460027	75	F	158.5	78	31.3	SCREW READJUSTMENT OF PFN	3	10:10 AM	T7	3	10:25 AM	165	T7	T9	T10	T11	T12	T12	L2
33	S	TLR	1439267	74	M	176.8	88	29.5	PROXIMAL FEMUR NAILING	3	1:10 PM	T6	3	1:30 PM	60	T6	T8	T10	T11			
34	S	DS	1440856	83	M	167.6	65	23.8	HEMIARTHROPLASTY	2	1:15 PM	T7	3	1:35 PM	50	T7	T9	T11	T12			
35	S	BK	1443025	74	F	167.6	52	19.1	HEMIARTHROPLASTY	3	9:20 AM	T7	3	9:35 AM	90	T7	T8	T9	T11	T12	T12	
36	P	TS	1383868	76	M	170.7	70	24.9	PROXIMAL FEMUR NAILING	3	12:00 PM	T8	3	12:15 PM	90	T8	T10	T11	T12	L2	L3	
37	S	AK	658746	77	F	152.4	52	22.4	HEMIARTHROPLASTY	3	11:15 AM	T8	3	11:30 AM	70	T8	T10	T11	T12	L1		
38	S	HL	1448857	69	M	176.8	78	26.1	HEMIARTHROPLASTY	3	9:10 AM	T7	3	9:25 AM	90	T7	T9	T10	T12	T12		
39	S	SK	1463394	78	F	167.6	90	32.9	HEMIARTHROPLASTY	3	10:50 AM	T7	3	11:10 AM	110	T7	T8	T9	T10	T12	T12	
40	P	KLS	1485910	82	M	176.8	72	24.1	HEMIARTHROPLASTY	3	2:35 PM	T7	3	2:50 PM	80	T7	T9	T11	T12	T12		
41	P	GR	1485917	66	F	158.5	65	26.2	HEMIARTHROPLASTY	3	9:40 AM	T7	3	9:55 AM	60	T7	T9	T11	T12			
42	S	NR	1472498	79	M	167.6	58	21.3	PROXIMAL FEMUR NAILING	3	10:20 AM	T7	3	10:35 AM	55	T7	T9	T10	T11			
43	P	JK	1489240	85	F	161.5	64	24.9	HEMIARTHROPLASTY	3	9:10 AM	T6	3	9:25 AM	65	T6	T8	T9	T11			
44	P	PD	1489933	73	F	158.5	70	28.2	PROXIMAL FEMUR NAILING	3	1:15 PM	T7	3	1:30 PM	70	T7	T9	T10	T12	T12		
45	S	NS	1474634	72	F	161.5	64	25	PROXIMAL FEMUR NAILING	3	12:30 PM	T6	3	12:45 PM	90	T6	T8	T9	T11	T12	T12	
46	P	KG	1123600	65	F	164.6	74	28	HEMIARTHROPLASTY	2	10:40 AM	T7	3	10:55 AM	65	T7	T9	T10	T12			
47	P	UG	1491068	73	F	158.5	70	28.2	PROXIMAL FEMUR NAILING	3	3:15 PM	T6	3	3:30 PM	80	T6	T8	T10	T12	T12		
48	P	PL	1494483	80	M	167.6	60	22	PROXIMAL FEMUR NAILING	3	9:40 AM	T7	3	9:55 AM	60	T7	T9	T11	T12			
49	S	BS	1476747	66	M	176.8	70	23.5	PROXIMAL FEMUR NAILING	3	11:15 AM	T7	3	11:30 AM	60	T7	T8	T10	T11			
50	P	MS	1497541	67	M	182.9	92	27.5	PROXIMAL FEMUR NAILING	3	9:30 AM	T7	3	9:45 AM	70	T7	T8	T10	T12			

S. No.	Randomization	Initials	MRD No.	Sensory level at 3.5 hr	Sensory level at 4 hr	Baseline HR (bpm)	HR at 0 mins (initiation of block)	HR at 30 mins	HR at 1 hr	HR at 1.5 hr	HR at 2 hr	HR at 2.5 hr	HR at 3 hr	HR at 3.5 hr	HR at 4 hr	Baseline SBP (mmHg)	SBP at 0 mins (initiation of block)	SBP at 30 mins	SBP at 1 hr	SBP at 1.5 hr	SBP at 2 hr	SBP at 2.5 hr	SBP at 3 hr	SBP at 3.5 hr	SBP at 4 hr	Baseline MAP (mmHg)	MAP at 0 mins (initiation of block)
1	P	MS	1383308			98	122	118	112	108	106					136	120	136	140	132	138					99	87
2	S	HS	1385954			84	82	86	88	90	86	88				140	146	140	150	152	142	138				108	99
3	P	B	1392678			108	106	98	102	100	98	98				120	108	126	140	142	136	130				85	83
4	S	AS	1391196			92	98	86	80	76	78	78				190	188	176	148	150	146	160				123	124
5	S	SL	1394202			88	86	82	92	98						160	156	136	130	148						107	104
6	P	SK	1396542			104	108	94	92	88	86	88				190	148	136	122	130	132	140				130	104
7	P	DR	1399066			60	84	78	76	82	80					160	152	148	142	140	138					106	105
8	P	YD	1233700			60	84	88	82	72	76					120	148	140	136	138	140					92	104
9	S	GSJ	1393519			84	82	80	84	84	86					150	130	132	128	126	130					100	87
10	S	JS	1395851			100	104	98	92	86	88					160	122	130	126	128	140					107	89
11	P	GK	1417728			70	78	72	64	62	62					158	148	120	116	122	124					114	108
12	S	GS	278089			78	88	72	74	76						110	116	118	104	120						82	85
13	P	KK	1427077			60	74	64	62	62						170	112	118	120	116						115	83
14	S	DS	1298161			78	88	80	78	76	72					130	140	116	114	122	120					97	91
15	S	TK	1416386			84	80	78	78	84	72	76				130	120	122	130	128	126	130				98	87
16	S	PS	1416696			88	102	86	88	82	84					180	170	140	122	130	136					125	118
17	S	KCG	217507			60	82	84	76	72	68					150	148	144	142	146	150					94	95
18	S	SK	1415130			112	108	104	106	100	94	92				130	132	116	120	122	130	130				90	95
19	P	HK	1428497			96	106	102	104	98	102	100	102			136	98	116	108	120	116	108	122			92	73
20	P	BS	1438022			94	86	84	80	78	72					130	176	164	148	142	140					90	120
21	S	GK	1417663			90	94	86	82	82						130	140	112	110	114						90	106
22	P	RR	1441626			80	86	80	84	78						132	108	112	114	110						104	88
23	S	US	1419916			76	74	80	82	78	82					170	138	126	136	140	136					116	101
24	S	UD	1430343			70	68	82	76	80						148	168	140	138	126						103	116
25	S	KK	432447			88	92	84	76	68	66	64				104	106	112	116	110	108	106				75	83
26	P	NRS	1444584			88	102	96	98	92	96	98	100			110	126	142	156	162	164	158	152			83	93
27	S	SS	239342			92	88	74	72	68	74	70				122	116	118	122	136	130	132				94	80
28	P	GKG	1445106			84	96	90	86	84	88					126	136	108	106	112	114					90	96
29	S	HK	1438806	L3		116	108	106	106	104	108	110	104	112		110	112	108	110	114	110	112	108	110		82	84
30	P	GK	1470377			68	88	72	76	66	70					146	150	112	108	106	112					102	110
31	P	KS	233839			74	70	68	66	64						160	154	130	132	140						120	111
32	P	S	1460027	L3		100	116	120	108	108	112	106	108	104		140	150	136	130	132	128	122	130	136		100	110
33	S	TLR	1439267			66	68	74	76	66						130	170	142	140	136						97	118
34	S	DS	1440856			80	82	84	78	80						150	130	108	104	110						98	90
35	S	BK	1443025			84	96	110	102	104	98	108				118	142	130	138	140	132	136				94	99
36	P	TS	1383868			74	78	64	60	58	54	56				110	122	134	126	142	138	128				83	89
37	S	AK	658746			84	92	86	80	76	84					130	116	120	108	112	112					91	89
38	S	HL	1448857			98	94	102	104	102	100					140	126	112	122	118	120					107	89
39	S	SK	1463394			74	78	76	72	80	74	76				120	180	156	122	118	108	106				80	107
40	P	KLS	1485910			90	88	86	86	82	88					140	120	112	118	120	114					100	88
41	P	GR	1485917			112	92	86	88	86						110	118	122	108	112						83	78
42	S	NR	1472498			78	76	68	72	70						140	130	122	130	120						100	94
43	P	JK	1489240			96	104	108	110	106						140	136	132	130	122						107	99
44	P	PD	1489933			66	68	66	62	68	70					140	156	110	122	146	148					107	113
45	S	NS	1474634			84	88	80	82	76	84	84				110	136	142	154	160	140	138				83	99
46	P	KG	1123600			68	76	66	68	72						150	112	116	124	108						110	83
47	P	UG	1491068			82	90	88	86	78	84					120	106	112	126	108	110					93	82
48	P	PL	1494483			90	86	68	70	72						160	116	122	108	110						119	84
49	S	BS	1476747			78	86	88	80	76						140	116	110	112	122						107	80
50	P	MS	1497541			82	80	84	76	78						160	112	104	110	108						116	91

S. No.	Randomization	Initials	MRD No.	MAP at 30 mins	MAP at 1 hr	MAP at 1.5 hr	MAP at 2 hr	MAP at 2.5 hr	MAP at 3 hr	MAP at 3.5 hr	MAP at 4 hr	Baseline DBP (mmHg)	DBP at 0 mins (initiation of block)	DBP at 30 mins	DBP at 1 hr	DBP at 1.5 hr	DBP at 2 hr	DBP at 2.5 hr	DBP at 3 hr	DBP at 3.5 hr	DBP at 4 hr	BaselineSpO2 (%)	SpO2 at 0 mins (initiation of block)	SpO2 at 30 mins	SpO2 at 1 hr	SpO2 at 1.5 hr	SpO2 at 2 hr
1	P	MS	1383308	100	100	95	99					80	70	82	80	76	80					96	98	98	98	98	97
2	S	HS	1385954	93	98	100	99	91				92	76	70	72	74	78	68				94	95	94	94	95	95
3	P	B	1392678	95	101	99	96	90				68	70	80	82	78	76	70				96	100	100	100	100	99
4	S	AS	1391196	112	100	97	98	107				90	92	80	76	70	74	80				96	96	97	97	96	96
5	S	SL	1394202	92	91	103						80	78	70	72	80						94	99	99	100	100	
6	P	SK	1396542	96	82	92	93	95				100	82	76	62	74	74	72				98	98	97	97	98	98
7	P	DR	1399066	101	98	93	94					80	82	78	76	70	72					94	98	98	99	99	100
8	P	YD	1233700	96	98	95	100					80	82	76	80	74	80					97	98	98	97	97	97
9	S	GSJ	1393519	91	88	89	90					76	66	70	68	70	70					97	100	100	100	100	100
10	S	JS	1395851	98	93	91	105					80	72	82	76	72	88					97	98	98	97	97	97
11	P	GK	1417728	92	84	85	88					92	90	78	68	66	70					97	99	98	98	99	99
12	S	GS	278089	93	83	85						68	70	80	72	68						98	98	100	100	100	
13	P	KK	1427077	86	88	85						88	68	72	72	70						100	100	99	100	99	
14	S	DS	1298161	80	83	87	85					80	66	64	68	70	68					96	97	97	96	96	97
15	S	TK	1416386	88	97	88	91	98				82	70	72	80	68	74	82				98	98	98	99	99	100
16	S	PS	1416696	95	87	98	97					98	92	72	70	82	78					98	98	97	97	98	98
17	S	KCG	217507	95	91	93	98					66	68	70	66	66	72					99	98	98	97	97	97
18	S	SK	1415130	91	88	90	97	94				70	76	78	72	74	80	76				94	96	98	98	97	96
19	P	HK	1428497	77	77	88	84	84	90			70	60	58	62	72	68	72	74			100	98	98	99	100	100
20	P	BS	1438022	113	97	94	100					70	92	88	72	70	80					97	96	97	97	97	97
21	S	GK	1417663	88	82	84						84	90	78	68	70						98	97	98	98	98	
22	P	RR	1441626	85	86	83						90	78	72	72	70						98	98	98	97	98	
23	S	US	1419916	93	95	99	93					90	82	76	74	78	72					98	98	96	96	97	96
24	S	UD	1430343	101	91	86						80	90	82	68	66						98	98	98	97	96	
25	S	KK	432447	84	87	85	84	81				60	72	70	72	72	72	68				93	100	100	100	100	100
26	P	NRS	1444584	99	111	103	105	101	99			70	76	78	88	74	76	72	72			98	98	97	96	97	98
27	S	SS	239342	85	89	92	93	93				80	62	68	72	70	74	74				97	98	98	97	98	98
28	P	GKG	1445106	85	86	88	91					72	76	74	76	76	80					98	98	97	96	96	97
29	S	HK	1438806	81	83	86	83	85	81	82		68	70	68	70	72	70	72	68	68		96	97	100	100	100	100
30	P	GK	1470377	83	83	83	84					80	90	68	70	72	70					97	96	96	96	97	98
31	P	KS	233839	98	96	97						100	90	82	78	76						95	97	98	97	96	
32	P	S	1460027	103	95	92	88	87	94	97		80	90	86	78	72	68	70	76	78		97	92	100	99	99	100
33	S	TLR	1439267	101	104	105						80	92	80	86	90						98	98	97	96	98	
34	S	DS	1440856	81	81	85						72	70	68	70	72						96	97	96	97	97	
35	S	BK	1443025	89	94	100	95	96				82	78	68	72	80	76	76				97	98	98	97	96	97
36	P	TS	1383868	95	95	98	93	91				70	72	76	80	76	70	72				96	95	96	97	98	97
37	S	AK	658746	87	81	76	79					72	76	70	68	58	62					96	98	99	98	98	97
38	S	HL	1448857	83	90	86	84					90	70	68	74	70	66					98	98	98	98	97	98
39	S	SK	1463394	100	87	86	81	83				60	70	72	70	70	68	72				98	98	97	97	97	98
40	P	KLS	1485910	83	86	91	82					80	72	68	70	76	66					97	98	97	98	98	97
41	P	GR	1485917	86	83	85						70	58	68	70	72						97	98	98	97	97	
42	S	NR	1472498	89	93	91						80	76	72	74	76						98	99	98	97	97	
43	P	JK	1489240	99	97	94						90	80	82	80	72						98	98	98	98	97	
44	P	PD	1489933	83	86	98	101					90	92	70	68	74	78					97	98	98	97	98	98
45	S	NS	1474634	98	103	108	97	97				60	80	76	78	82	76	76				99	99	98	97	97	98
46	P	KG	1123600	87	88	81						90	68	72	70	68						97	98	97	96	97	
47	P	UG	1491068	83	89	81	85					80	70	68	70	68	72					98	98	97	98	98	97
48	P	PL	1494483	87	81	83						98	68	70	68	70						95	97	98	98	97	
49	S	BS	1476747	83	83	86						90	62	70	68	68						97	98	98	96	97	
50	P	MS	1497541	83	83	77						94	80	72	70	62						97	98	97	98	98	

S. No.	Randomization	Initials	MRD No.	SpO2 at 2.5 hr	SpO2 at 3 hr	SpO2 at 3.5 hr	SpO2 at 4 hr	Baseline RR (per minute)	RR at 0 mins (initiationo f block)	RR at 30 mins	RR at 1 hr	RR at 1.5 hr	RR at 2 hr	RR at 2.5 hr	RR at 3 hr	RR at 3.5 hr	RR at 4 hr	Baseline HR (bpm)	HR at 0 min (on arrival in PACU)	HR at 1st hr	HR at 2nd hr	HR at 3rd hr	HR at 4th hr	HR at 6th hr	HR at 8th hr
1	P	MS	1383308					18	22	20	18	18	18					98	140	116	108	112	104	106	102
2	S	HS	1385954	95				22	22	22	20	22	22	18				84	90	92	86	88	78	82	84
3	P	B	1392678	99				18	20	18	18	18	18	18				108	110	94	92	92	96	98	96
4	S	AS	1391196	96				18	18	18	18	18	18	18				92	88	90	86	92	92	94	84
5	S	SL	1394202					18	18	16	16	20						88	98	96	88	102	98	84	88
6	P	SK	1396542	98				18	22	18	18	16	16	16				104	90	96	92	94	94	90	98
7	P	DR	1399066					22	24	20	16	16	16					60	64	62	74	62	68	70	72
8	P	YD	1233700					16	20	20	16	16	16					60	70	64	68	64	76	88	86
9	S	GSJ	1393519					16	18	18	18	16	16					84	96	92	68	76	108	92	88
10	S	JS	1395851					20	22	20	18	20	20					100	98	82	98	94	90	88	86
11	P	GK	1417728					18	20	18	16	16	16					70	80	76	74	74	82	86	94
12	S	GS	278089					20	20	20	20	20						78	82	78	76	92	96	88	90
13	P	KK	1427077					20	20	18	18	18						60	74	72	68	62	66	66	78
14	S	DS	1298161					16	20	18	16	16	16					78	88	86	82	80	94	96	92
15	S	TK	1416386	99				18	16	16	16	18	18	16				84	86	84	86	80	76	82	78
16	S	PS	1416696					18	20	18	16	16	16					88	82	88	84	84	88	86	88
17	S	KCG	217507					16	20	18	18	18	18					60	74	78	76	68	82	78	70
18	S	SK	1415130	96				18	22	20	18	18	16	16				112	88	96	92	94	112	116	98
19	P	HK	1428497	98	98			20	22	20	18	18	18	18	18			96	102	106	104	100	106	110	106
20	P	BS	1438022					20	18	18	16	16	18					94	78	72	88	82	96	82	98
21	S	GK	1417663					18	20	18	16	16						90	72	68	76	80	98	92	84
22	P	RR	1441626					18	18	18	18	18						80	96	86	82	80	82	88	86
23	S	US	1419916					18	18	16	18	18	18					76	66	72	74	72	76	86	80
24	S	UD	1430343					20	20	18	18	18						70	84	68	78	76	80	90	94
25	S	KK	432447	100				18	20	18	18	16	16	16				88	64	62	60	68	70	78	64
26	P	NRS	1444584	98	97			18	22	20	18	18	20	20	20			88	106	88	94	96	94	92	96
27	S	SS	239342	98				18	20	18	16	16	16	18				92	82	86	84	102	98	100	98
28	P	GKG	1445106					18	20	20	20	20	20					84	72	76	70	74	80	68	74
29	S	HK	1438806	100	100	100		18	18	20	20	18	16	16	16	18		116	122	130	134	126	124	120	116
30	P	GK	1470377					18	18	18	16	16	16					68	76	72	76	70	74	66	68
31	P	KS	233839					18	18	18	16	16						74	76	76	78	80	80	76	94
32	P	S	1460027	100	99	99		18	20	20	20	18	18	18	20	20		100	116	118	118	120	116	112	110
33	S	TLR	1439267					18	18	18	16	16						66	60	62	62	66	66	68	68
34	S	DS	1440856					18	18	16	16	16						80	84	90	92	84	80	82	92
35	S	BK	1443025	98				18	18	20	20	18	18	18				84	128	126	124	122	118	98	94
36	P	TS	1383868	97				20	24	20	20	18	18	18				74	54	62	60	72	68	74	94
37	S	AK	658746					20	22	22	20	20	20					84	74	80	76	84	82	86	84
38	S	HL	1448857					18	22	20	18	18	18					98	96	94	96	102	104	107	98
39	S	SK	1463394	98				18	18	18	18	16	16	16				74	70	72	86	70	78	84	96
40	P	KLS	1485910					16	18	18	18	20	18					90	104	92	96	88	86	88	80
41	P	GR	1485917					18	20	20	18	20						112	90	92	100	118	122	120	114
42	S	NR	1472498					18	18	18	16	16						78	58	70	72	88	84	80	84
43	P	JK	1489240					18	20	20	20	20						96	98	100	94	98	92	102	76
44	P	PD	1489933					22	22	24	22	22	22					66	70	72	74	86	88	84	80
45	S	NS	1474634	98				20	22	18	18	18	16	18				84	92	84	88	84	82	80	78
46	P	KG	1123600					20	24	20	18	20						68	80	82	72	70	76	64	68
47	P	UG	1491068					20	20	20	18	18	20					82	86	80	78	86	88	80	76
48	P	PL	1494483					20	20	20	22	20						90	80	68	68	58	82	72	60
49	S	BS	1476747					18	20	20	20	20						78	86	80	80	72	82	96	98
50	P	MS	1497541					20	20	18	22	18						82	88	86	90	94	82	94	80

S. No.	Randomization	Initials	MRD No.	HR at 12th hr	HR at 16th hr	HR at 20th hr	HR at 24th hr	Baseline SBP (mmHg)	SBP at 0 min (on arrival in PACU)	SBP at 1st hr	SBP at 2nd hr	SBP at 3rd hr	SBP at 4th hr	SBP at 6th hr	SBP at 8th hr	SBP at 12th hr	SBP at 16th hr	SBP at 20th hr	SBP at 24th hr	BaselineDBP (mmHg)	DBP at 0 min (on arrival in PACU)	DBP at 1st hr	DBP at 2nd hr	DBP at 3rd hr	DBP at 4th hr
1	P	MS	1383308	104	98	96	90	136	126	130	110	130	126	136	120	110	120	116	136	80	76	70	68	72	70
2	S	HS	1385954	86	80	74	88	140	160	162	150	152	136	144	140	138	120	132	130	92	84	78	76	80	82
3	P	B	1392678	92	88	94	92	120	116	108	122	120	136	118	138	120	122	130	122	68	78	68	74	72	72
4	S	AS	1391196	80	88	86	82	190	180	166	160	150	144	160	168	136	140	142	138	90	100	96	84	70	78
5	S	SL	1394202	74	78	82	86	160	148	130	130	140	146	130	140	136	120	126	120	80	80	70	72	80	76
6	P	SK	1396542	92	88	88	86	190	118	110	112	118	120	114	116	120	118	108	122	100	70	80	72	70	72
7	P	DR	1399066	62	60	64	70	160	158	150	162	140	132	128	130	142	150	146	150	80	68	66	90	64	66
8	P	YD	1233700	72	62	66	58	120	160	108	126	116	114	126	104	148	138	136	150	80	74	56	54	60	50
9	S	GSJ	1393519	96	84	74	78	150	132	136	138	146	140	130	128	140	136	130	120	76	72	80	80	98	88
10	S	JS	1395851	84	78	88	86	160	140	146	160	140	142	166	142	138	140	136	140	80	90	66	80	78	60
11	P	GK	1417728	86	88	80	78	158	126	120	116	122	130	140	142	140	126	122	132	92	98	76	74	72	86
12	S	GS	278089	72	88	82	84	110	120	136	140	118	116	112	126	140	138	130	126	68	70	80	82	72	62
13	P	KK	1427077	76	84	72	66	170	160	142	148	150	152	146	140	152	128	128	140	88	72	72	72	86	80
14	S	DS	1298161	80	84	82	86	130	106	110	108	112	130	136	140	142	130	112	110	80	58	70	68	66	70
15	S	TK	1416386	88	80	88	86	130	124	130	130	124	120	126	110	120	140	120	124	82	80	90	68	60	64
16	S	PS	1416696	100	92	88	86	180	140	120	120	140	136	150	120	136	126	146	150	98	80	68	70	80	82
17	S	KCG	217507	72	74	76	78	150	160	142	138	122	142	132	134	130	122	144	138	66	80	50	58	54	52
18	S	SK	1415130	110	112	110	120	130	132	130	140	136	146	160	168	140	142	154	146	70	62	68	90	86	78
19	P	HK	1428497	108	94	98	88	136	116	112	104	106	116	126	118	140	120	112	110	70	68	60	70	72	62
20	P	BS	1438022	108	110	102	106	130	120	120	122	110	130	120	130	116	118	128	130	70	80	70	68	70	72
21	S	GK	1417663	80	68	66	72	130	110	120	120	116	118	130	116	120	114	122	120	84	72	70	68	78	72
22	P	RR	1441626	90	88	88	76	132	140	112	110	112	114	128	140	138	150	148	154	90	100	92	90	64	70
23	S	US	1419916	82	68	72	78	170	150	150	142	148	150	152	142	130	136	140	142	90	82	80	78	80	82
24	S	UD	1430343	90	98	88	88	148	150	148	138	146	148	150	150	166	156	154	148	80	56	54	52	52	56
25	S	KK	432447	62	68	88	70	104	136	148	140	110	128	150	132	110	112	126	130	60	80	90	86	86	80
26	P	NRS	1444584	90	94	96	92	110	182	174	188	180	160	150	152	130	120	110	110	70	78	76	98	120	90
27	S	SS	239342	92	106	112	102	122	122	122	124	124	152	148	136	148	148	136	140	80	68	78	68	72	74
28	P	GKG	1445106	88	92	70	76	126	130	126	122	130	140	132	130	146	150	138	120	72	80	70	68	72	90
29	S	HK	1438806	112	108	86	94	110	110	120	130	128	118	120	138	110	108	100	108	68	70	84	90	86	72
30	P	GK	1470377	76	88	68	72	146	108	110	108	112	104	122	126	130	154	132	114	80	68	72	66	70	68
31	P	KS	233839	90	82	76	72	160	130	120	122	130	136	140	160	148	130	132	128	100	80	76	72	82	80
32	P	S	1460027	112	108	104	102	140	140	140	138	130	128	124	126	108	140	128	138	80	82	76	68	70	66
33	S	TLR	1439267	68	62	70	68	130	132	150	160	154	134	138	136	132	120	126	130	80	56	54	56	58	52
34	S	DS	1440856	94	90	86	84	150	126	120	122	122	130	120	112	118	110	106	116	72	68	64	66	64	70
35	S	BK	1443025	90	84	88	82	118	98	144	124	136	132	140	136	124	110	180	130	82	62	60	66	80	86
36	P	TS	1383868	84	66	74	78	110	130	150	154	160	154	134	166	156	140	136	118	70	56	60	64	82	70
37	S	AK	658746	102	112	98	96	130	126	110	114	120	110	112	120	130	134	124	140	72	68	70	72	80	68
38	S	HL	1448857	96	108	106	100	140	120	128	132	136	156	160	156	152	156	166	150	90	62	82	80	86	90
39	S	SK	1463394	74	72	74	76	120	118	142	146	158	160	154	144	150	142	140	138	60	70	72	78	70	84
40	P	KLS	1485910	82	88	82	80	140	160	112	106	128	126	126	108	112	100	110	128	80	90	78	54	50	54
41	P	GR	1485917	116	92	102	110	110	100	130	110	138	122	104	128	100	110	100	112	70	62	74	64	76	72
42	S	NR	1472498	70	74	70	52	140	142	148	136	120	116	104	120	116	146	138	100	80	68	50	54	50	48
43	P	JK	1489240	74	70	78	76	140	128	130	120	124	138	134	130	126	116	106	118	90	62	64	56	66	78
44	P	PD	1489933	90	98	94	78	140	116	136	138	160	150	156	140	140	130	136	132	90	48	50	54	62	66
45	S	NS	1474634	74	74	80	76	110	132	160	152	154	162	160	156	166	168	160	160	60	58	56	66	66	70
46	P	KG	1123600	90	84	80	74	150	112	108	120	116	130	136	140	150	146	156	158	90	80	68	72	70	80
47	P	UG	1491068	78	82	94	82	120	118	130	112	116	122	124	126	130	116	120	112	80	72	80	70	68	72
48	P	PL	1494483	82	80	74	88	160	110	128	130	130	138	140	130	138	130	100	110	98	70	78	74	80	90
49	S	BS	1476747	90	82	90	88	140	136	122	126	130	132	142	112	128	130	140	132	90	82	72	64	80	78
50	P	MS	1497541	88	82	98	70	160	134	136	126	124	130	160	160	130	132	120	140	94	84	80	78	84	90

S. No.	Randomization	Initials	MRD No.	DBP at 6th hr	DBP at 8th hr	DBP at 12th hr	DBP at 16th hr	DBP at 20th hr	DBP at 24th hr	BaselineSpO2 (%)	SpO2 at 0 min (on arrival in PACU)	SpO2 at 1st hr	SpO2 at 2nd hr	SpO2 at 3rd hr	SpO2 at 4th hr	SpO2 at 6th hr	SpO2 at 8th hr	SpO2 at 12th hr	SpO2 at 16th hr	SpO2 at 20th hr	SpO2 at 24th hr	SL at 0 min (on arrival in PACU)	SL at 1st hr	SL at 2nd hr	SL at 3rd hr
1	P	MS	1383308	82	80	70	68	80	80	96	97	96	96	96	95	95	96	97	97	97	96	L1	L4		
2	S	HS	1385954	76	80	70	72	76	78	94	95	96	94	95	94	95	94	95	95	94	95	L3			
3	P	B	1392678	72	80	76	72	80	76	96	97	98	97	96	98	98	96	97	97	98	98	T12	L2	L4	
4	S	AS	1391196	90	78	70	80	72	80	96	96	96	95	95	95	95	94	94	95	94	94	T12	L2	L5	
5	S	SL	1394202	70	68	76	70	72	82	94	100	100	100	97	96	96	95	96	95	95	95	T11	L2	L4	
6	P	SK	1396542	86	76	72	76	68	64	98	95	94	94	95	95	94	94	94	95	94	94	L1	L4	S1	
7	P	DR	1399066	60	62	64	68	66	64	94	94	94	93	93	92	94	95	94	94	92	94	L1	L4		
8	P	YD	1233700	56	54	70	76	80	66	97	97	98	98	96	96	96	98	98	98	97	98	T12	L4		
9	S	GSJ	1393519	78	70	82	80	72	82	97	100	100	97	97	98	98	96	96	96	94	96	T10	T12	L2	L5
10	S	JS	1395851	84	72	82	82	76	88	97	98	96	96	95	96	98	98	96	96	97	98	L1	L4		
11	P	GK	1417728	90	82	78	66	70	82	97	99	98	98	99	99	98	98	96	97	98	98	T12	L2	L5	
12	S	GS	278089	60	76	90	86	78	74	98	100	100	100	98	96	96	95	96	96	96	96	T12	L3	S1	
13	P	KK	1427077	76	72	76	70	68	82	100	99	99	98	96	98	99	99	100	100	98	97	T12	L3		
14	S	DS	1298161	68	90	82	72	68	70	96	99	99	99	98	98	99	96	96	96	97	98	T12	L4		
15	S	TK	1416386	70	60	66	60	80	80	98	96	96	95	93	94	93	96	96	95	96	94	L2	L4		
16	S	PS	1416696	80	82	84	82	80	84	98	96	96	96	97	96	95	96	97	97	97	96	T12	L3	S1	
17	S	KCG	217507	46	52	54	52	56	58	99	98	98	98	97	97	98	98	96	96	98	98	T12	L2	S1	
18	S	SK	1415130	80	82	90	92	82	80	94	96	98	99	98	98	97	96	96	97	97	97	L1	L5		
19	P	HK	1428497	70	70	80	66	68	66	100	96	98	98	97	96	97	98	98	98	98	97	L1	L4		
20	P	BS	1438022	70	72	68	70	72	80	97	96	96	94	96	96	96	98	97	96	96	96	L1	L4		
21	S	GK	1417663	90	72	70	80	72	68	98	98	96	97	98	98	98	97	97	97	98	97	L2	L5	S1	
22	P	RR	1441626	84	84	70	80	90	80	98	96	99	98	99	98	97	98	97	96	96	97	T12	L3		
23	S	US	1419916	90	76	70	72	80	78	98	100	100	98	96	96	94	96	97	97	96	96	T12	L3		
24	S	UD	1430343	58	68	68	60	56	62	98	98	96	95	97	98	98	98	99	98	96	97	T12	L3		
25	S	KK	432447	90	90	72	76	62	90	93	94	94	94	96	95	94	94	96	95	95	95	L1	L4		
26	P	NRS	1444584	88	74	64	80	70	72	98	98	97	95	98	96	98	99	97	96	96	97	T12	L3		
27	S	SS	239342	74	82	70	76	64	66	97	98	98	100	96	98	98	96	97	98	97	97	T12	L2	L5	
28	P	GKG	1445106	76	80	90	86	90	72	98	98	97	96	96	97	98	98	97	96	96	96	T12	L3		
29	S	HK	1438806	70	86	66	68	62	70	96	100	100	100	100	96	97	95	96	95	95	95	L4			
30	P	GK	1470377	72	70	68	80	76	68	97	97	97	96	96	95	98	98	96	96	97	97	L1	L4		
31	P	KS	233839	84	88	70	76	74	76	95	97	97	96	96	97	98	97	96	97	96	96	T11	L2	L4	
32	P	S	1460027	66	66	70	70	90	74	97	96	94	94	97	98	96	98	98	96	98	98	L3			
33	S	TLR	1439267	56	52	58	72	68	62	98	99	97	98	97	97	96	97	96	98	97	97	T11	T12	L3	
34	S	DS	1440856	72	80	80	68	64	68	96	98	96	95	94	96	97	98	96	96	96	97	T12	L3		
35	S	BK	1443025	80	68	64	76	66	76	97	96	99	98	97	98	99	94	96	98	97	98	L1	L3		
36	P	TS	1383868	68	92	72	90	82	70	96	98	94	95	96	96	94	95	97	96	96	97	L4			
37	S	AK	658746	70	78	70	70	64	64	96	95	96	97	97	98	96	96	98	99	98	98	L2	L4		
38	S	HL	1448857	90	68	84	90	90	86	98	98	97	98	97	96	98	98	96	97	97	98	T12	L3		
39	S	SK	1463394	80	72	70	68	72	76	98	98	94	94	96	96	98	97	96	98	96	96	T12	L3	L5	
40	P	KLS	1485910	56	68	72	70	52	50	97	96	98	98	97	96	98	98	96	94	96	96	L1	L4		
41	P	GR	1485917	70	78	70	70	60	62	97	99	97	95	97	95	98	96	97	96	95	96	T12	L3		
42	S	NR	1472498	80	70	90	90	60	60	98	93	92	94	94	96	94	98	96	94	96	94	T12	L3		
43	P	JK	1489240	72	82	84	54	58	72	98	98	97	96	98	96	98	97	98	97	97	96	T11	L1	L4	
44	P	PD	1489933	64	60	80	60	60	64	97	98	98	96	96	97	98	98	96	98	96	97	L2			
45	S	NS	1474634	74	74	76	78	68	70	99	99	98	99	97	96	97	98	98	98	98	99	L4			
46	P	KG	1123600	86	88	90	86	66	90	97	97	98	98	96	96	97	98	98	96	98	98	T12	L3		
47	P	UG	1491068	64	74	82	76	82	68	98	98	97	96	98	98	97	96	98	98	98	97	T12	L3		
48	P	PL	1494483	82	90	80	68	60	80	95	99	98	97	98	94	94	95	96	94	95	95	T12	L3		
49	S	BS	1476747	90	80	78	90	68	70	97	97	98	98	96	97	98	98	97	98	99	98	T12	L3		
50	P	MS	1497541	80	100	90	88	80	96	97	96	96	97	94	96	97	96	98	96	97	96	T12	L3		

S. No.	Randomization	Initials	MRD No.	SL at 4th hr	SL at 6th hr	SL at 8th hr	SL at 12th hr	SL at 16th hr	SL at 20th hr	SL at 24th hr	Pre-operative VAS score at rest	VAS score at 0 min (on arrival in PACU)	VAS score at 1st hr	VAS score at 2nd hr	VAS score at 3rd hr	VAS score at 4th hr	VAS score at 6th hr	VAS score at 8th hr	VAS score at 12th hr	VAS score at 16th hr	VAS score at 20th hr	VAS score at 24th hr	Quadriceps muscle strength at 24 hrs	Quadriceps muscle strength at 48 hrs	Weight-bearing at 24 hrs
1	P	MS	1383308								10	3	6	1	2	3	0	0	0	0	2	0	1	3	2
2	S	HS	1385954								9	0	0	0	3	6	2	0	0	2	2	0	2	4	1
3	P	B	1392678								9	2	2	5	1	0	0	3	0	0	1	2	1	3	2
4	S	AS	1391196								9	0	0	2	8	2	2	2	0	2	2	2	2	4	1
5	S	SL	1394202								10	0	0	2	4	6	2	2	0	0	2	0	1	4	1
6	P	SK	1396542								9	0	0	0	0	0	0	0	0	2	2	1	2	4	2
7	P	DR	1399066								10	0	0	0	0	0	1	2	2	1	0	0	2	4	2
8	P	YD	1233700								10	0	0	0	1	4	8	2	1	0	0	0	2	4	2
9	S	GSJ	1393519								10	0	0	0	2	6	1	0	4	2	0	0	2	4	1
10	S	JS	1395851								10	0	0	2	5	2	8	2	2	6	3	4	1	2	1
11	P	GK	1417728								10	0	0	0	0	0	2	6	1	2	2	2	2	4	2
12	S	GS	278089								10	0	0	0	2	6	2	2	0	2	2	4	1	3	2
13	P	KK	1427077								10	0	0	0	0	0	0	0	2	0	0	0	2	5	2
14	S	DS	1298161								7	0	0	0	0	2	2	5	2	1	1	1	2	4	1
15	S	TK	1416386								8	1	1	1	1	1	5	1	2	2	3	4	1	3	1
16	S	PS	1416696								9	0	0	0	0	0	1	1	6	1	2	2	2	4	2
17	S	KCG	217507								9	0	0	0	2	5	2	1	1	2	2	3	1	2	1
18	S	SK	1415130								10	0	0	0	1	2	6	1	0	2	2	3	1	3	2
19	P	HK	1428497								10	0	0	0	0	2	8	0	2	1	0	0	2	5	2
20	P	BS	1438022								9	0	0	0	0	0	0	2	6	2	0	0	1	4	2
21	S	GK	1417663								9	0	0	0	2	7	2	1	2	2	2	2	1	3	1
22	P	RR	1441626								7	0	0	0	0	0	0	0	2	0	2	2	1	4	2
23	S	US	1419916								10	0	0	0	0	2	7	0	2	2	2	4	2	4	2
24	S	UD	1430343								10	0	0	0	0	2	4	4	0	0	4	4	1	3	1
25	S	KK	432447								10	0	0	0	0	2	6	1	5	2	6	2	1	3	1
26	P	NRS	1444584								5	0	0	0	3	0	0	2	0	0	2	2	1	4	2
27	S	SS	239342								9	0	0	3	4	2	6	0	0	4	2	0	1	3	1
28	P	GKG	1445106								7	0	0	0	0	0	0	0	2	3	0	0	1	4	2
29	S	HK	1438806								8	0	0	0	2	2	7	2	6	2	2	0	1	4	2
30	P	GK	1470377								10	0	0	0	0	2	0	0	0	5	2	0	2	4	2
31	P	KS	233839								8	0	0	0	0	0	0	7	2	2	0	0	2	4	1
32	P	S	1460027								9	2	6	2	2	4	2	4	2	2	5	6	1	2	1
33	S	TLR	1439267								5	0	0	0	0	0	4	2	0	2	3	3	1	3	1
34	S	DS	1440856								4	0	0	0	0	0	0	0	2	4	0	0	1	4	1
35	S	BK	1443025								6	0	0	0	0	0	2	0	3	2	2	0	1	3	1
36	P	TS	1383868								10	0	0	0	0	0	2	7	2	0	2	4	1	3	1
37	S	AK	658746								8	0	0	0	2	6	2	2	3	3	3	2	2	4	1
38	S	HL	1448857								8	0	0	0	3	5	0	3	2	2	2	0	1	3	2
39	S	SK	1463394								6	0	0	0	2	6	2	2	7	3	1	4	1	3	1
40	P	KLS	1485910								9	0	0	0	0	3	0	0	0	2	3	3	2	4	2
41	P	GR	1485917								10	4	2	0	0	3	0	0	0	2	2	2	1	4	1
42	S	NR	1472498								8	0	0	0	0	2	2	7	3	2	4	5	1	2	2
43	P	JK	1489240								10	0	0	0	0	3	0	0	2	0	0	0	2	4	1
44	P	PD	1489933								8	0	0	0	0	0	0	0	0	0	0	0	2	4	2
45	S	NS	1474634								9	0	0	0	3	6	2	2	2	3	3	5	1	3	1
46	P	KG	1123600								9	0	0	0	0	0	0	2	2	0	3	0	1	4	2
47	P	UG	1491068								10	0	0	0	0	0	0	0	0	2	2	0	2	4	1
48	P	PL	1494483								9	0	0	0	0	2	3	0	3	0	0	0	1	4	2
49	S	BS	1476747								10	0	0	0	0	2	2	3	1	3	2	0	1	4	1
50	P	MS	1497541								9	0	0	0	0	0	0	2	0	0	0	0	2	4	2

S. No.	Randomization	Initials	MRD No.	Weight-bearing at 48 hrs	VAS score at 24 hours at rest	Time at which first rescue opioid analgesic needed	Total amount of opioid analgesic used in 24 hours period (Tramadol in mg)	Total amount of opioid analgesic used in 24 hours period (Fentanyl in mcg)	Total duration of analgesia of PENG/ SIFI (mins)	Overall patient satisfaction for pain management (within 24 hours)	Surgeon's satisfaction to anaesthesia services for overall pain management
1	P	MS	1383308	3	0	3 hrs	200mg	0	180	very dissatisfied	dissatisfied
2	S	HS	1385954	4	0	6 hrs 20 mins	150 mg	0	380	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
3	P	B	1392678	5	2	4 hrs 40 mins	100mg	0	280	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
4	S	AS	1391196	4	2	5 hrs 45 mins	200mg	0	345	neither satisfied nor dissatisfied	satisfied
5	S	SL	1394202	4	0	4 hrs 10 mins	150mg	0	250	neither satisfied nor dissatisfied	satisfied
6	P	SK	1396542	4	1	20 hrs 45 mins	50mg	0	1245	very satisfied	very satisfied
7	P	DR	1399066	4	0	13 hrs 20 mins	100mg	0	800	very satisfied	very satisfied
8	P	YD	1233700	4	0	6 hrs 15 mins	100mg	0	375	satisfied	satisfied
9	S	GSJ	1393519	3	0	5 hrs 20 mins	200mg	0	320	satisfied	satisfied
10	S	JS	1395851	4	4	5 hrs 10 mins	200mg	0	310	dissatisfied	dissatisfied
11	P	GK	1417728	4	2	10 hrs	150mg	0	600	satisfied	satisfied
12	S	GS	278089	4	4	5 hrs 40 mins	200mg	0	340	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
13	P	KK	1427077	4	0	15 hrs 35 mins	100mg	0	935	very satisfied	very satisfied
14	S	DS	1298161	4	1	9 hrs 25 mins	150mg	0	565	satisfied	satisfied
15	S	TK	1416386	4	4	8 hrs 40 mins	200mg	0	520	dissatisfied	dissatisfied
16	S	PS	1416696	4	2	13 hrs 45 mins	50mg	0	825	very satisfied	very satisfied
17	S	KCG	217507	3	3	5 hrs 30 mins	200mg	0	330	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
18	S	SK	1415130	4	3	8 hrs 40 mins	150mg	0	520	satisfied	satisfied
19	P	HK	1428497	5	0	9 hrs 10 mins	100mg	0	550	dissatisfied	neither satisfied nor dissatisfied
20	P	BS	1438022	4	0	14 hrs 15 mins	50mg	0	855	very satisfied	satisfied
21	S	GK	1417663	4	2	5 hrs 10 mins	150mg	0	310	neither satisfied nor dissatisfied	satisfied
22	P	RR	1441626	5	2	12 hrs 15 mins	100mg	0	735	satisfied	satisfied
23	S	US	1419916	4	4	8 hrs 10 mins	150mg	0	490	neither satisfied nor dissatisfied	satisfied
24	S	UD	1430343	5	4	7 hrs 35 mins	150mg	0	455	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
25	S	KK	432447	4	2	8 hrs 20 mins	200mg	0	500	dissatisfied	dissatisfied
26	P	NRS	1444584	4	2	9 hrs 5 mins	50mg	0	545	very satisfied	very satisfied
27	S	SS	239342	3	0	5 hrs	100mg	0	300	dissatisfied	dissatisfied
28	P	GKG	1445106	5	0	17 hrs 35 mins	50mg	0	1055	satisfied	satisfied
29	S	HK	1438806	4	0	9 hrs 50 mins	150mg	0	590	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
30	P	GK	1470377	4	0	18 hrs	100mg	0	1080	very satisfied	very satisfied
31	P	KS	233839	4	0	9 hrs 30 mins	150 mg	0	570	satisfied	satisfied
32	P	S	1460027	3	6	4 hrs 35 mins	150mg	0	275	very dissatisfied	dissatisfied
33	S	TLR	1439267	4	3	8 hrs 30 mins	100mg	0	510	satisfied	satisfied
34	S	DS	1440856	3	0	18 hrs 25 mins	50mg	0	1105	very satisfied	very satisfied
35	S	BK	1443025	5	0	7 hrs 25 mins	150mg	0	445	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
36	P	TS	1383868	5	4	10 hrs 45 mins	150mg	0	645	neither satisfied nor dissatisfied	satisfied
37	S	AK	658746	4	2	6 hrs 30 mins	150mg	0	390	dissatisfied	neither satisfied nor dissatisfied
38	S	HL	1448857	4	0	5 hrs 35 mins	200mg	0	335	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
39	S	SK	1463394	3	4	6 hrs 30 mins	150mg	0	390	very dissatisfied	dissatisfied
40	P	KLS	1485910	5	3	7 hrs 10 mins	50mg	0	430	very satisfied	very satisfied
41	P	GR	1485917	4	2	2 hrs 5 mins	150mg	0	125	dissatisfied	neither satisfied nor dissatisfied
42	S	NR	1472498	5	5	9 hrs 25 mins	150mg	0	565	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
43	P	JK	1489240	4	0	5 hrs 35 mins	100mg	0	335	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
44	P	PD	1489933	4	0	19 hrs 30 mins	50mg	0	1170	very satisfied	satisfied
45	S	NS	1474634	4	5	7 hrs 15 mins	150mg	0	435	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
46	P	KG	1123600	4	0	12 hrs 5 mins	100mg	0	725	satisfied	satisfied
47	P	UG	1491068	4	0	16 hrs 30 mins	150mg	0	990	very satisfied	very satisfied
48	P	PL	1494483	5	0	7 hrs 5 mins	100mg	0	425	satisfied	satisfied
49	S	BS	1476747	4	0	6 hrs 40 mins	150mg	0	400	neither satisfied nor dissatisfied	neither satisfied nor dissatisfied
50	P	MS	1497541	4	0	15 hrs 15 mins	50mg	0	915	very satisfied	very satisfied

S. No.	Randomization	Initials	MRD No.	Age (years)	Gender	Height (cm)	Weight (Kg)	BMI	Type of hip surgery	ASA grade	Time of sub-arachnoid block	Level of sensory blockade	Level of motor blockade (Modified Bromage scale)	Time of institution of PENG/ SIFI Block	Duration of surgery in minutes (time from skin incision to closure)	Sensory level at 0 mins (initiation of block)	Sensory level at 30 mins	Sensory level at 1 hr	Sensory level at 1.5 hr	Sensory level at 2 hr	Sensory level at 2.5 hr	Sensory level at 3 hr
51	P	RMS	1496033	60	M	176.8	65	21.8	HEMIARTHROPLASTY	3	12:45 PM	T7	3	1:00 PM	80	T7	T8	T10	T11	T12		
52	P	AA	1504140	80	F	158.5	68	27.4	HEMIARTHROPLASTY	3	11:45 AM	T6	3	12:00 PM	75	T6	T8	T11	T12	L1		
53	S	BK	1479268	65	F	158.5	65	26.2	PROXIMAL FEMUR NAILING	2	5:00 PM	T7	3	5:15 PM	70	T7	T9	T11	T12			
54	P	RS	1504605	72	M	176.8	62	20.8	PROXIMAL FEMUR NAILING	2	8:45 AM	T7	3	9:00 AM	75	T7	T9	T11	T12	T12		
55	S	SS	314282	68	M	155.7	80	24.6	HEMIARTHROPLASTY	3	9:40 AM	T7	3	9:45 AM	70	T7	T9	T10	T12	T12		
56	S	SR	1507767	75	F	158.5	68	27.4	PROXIMAL FEMUR NAILING	3	10:15 AM	T7	3	10:30 AM	70	T7	T8	T10	T12	T12		
57	P	RS	1506352	50	M	173.7	75	25.9	PROXIMAL FEMUR NAILING	3	11:15 AM	T8	3	11:30 AM	80	T8	T9	T10	T12	T12	L3	
58	P	SKB	1506309	66	M	173.7	82	28.3	HEMIARTHROPLASTY	3	9:45 AM	T6	3	10:00 AM	110	T6	T7	T9	T11	T12	L1	
59	S	JPS	1515039	70	M	155.4	76	24	HEMIARTHROPLASTY	3	10:40 AM	T6	3	11:00 AM	80	T6	T7	T9	T10	T12	T12	
60	P	KN	1514212	64	M	170.7	70	24.9	HEMIARTHROPLASTY	3	12:00 PM	T7	3	12:15 PM	70	T7	T9	T10	T12	T12		

S. No.	Randomization	Initials	MRD No.	Sensory level at 3.5 hr	Sensory level at 4 hr	Baseline HR (bpm)	HR at 0 mins (initiation of block)	HR at 30 mins	HR at 1 hr	HR at 1.5 hr	HR at 2 hr	HR at 2.5 hr	HR at 3 hr	HR at 3.5 hr	HR at 4 hr	Baseline SBP (mmHg)	SBP at 0 mins (initiation of block)	SBP at 30 mins	SBP at 1 hr	SBP at 1.5 hr	SBP at 2 hr	SBP at 2.5 hr	SBP at 3 hr	SBP at 3.5 hr	SBP at 4 hr	Baseline MAP (mmHg)	MAP at 0 mins (initiation of block)
51	P	RMS	1496033			82	86	88	102	106	110					130	106	132	140	130	136					103	87
52	P	AA	1504140			82	86	80	88	80	78					130	106	104	100	108	110					90	77
53	S	BK	1479268			92	98	90	86	88						146	112	110	108	116						109	83
54	P	RS	1504605			92	88	86	80	88	76					116	108	112	104	110	108					87	83
55	S	SS	314282			84	92	86	84	82	80					126	150	148	140	146	130					90	89
56	S	SR	1507767			66	76	78	68	64	66					110	102	104	110	104	106					83	75
57	P	RS	1506352			82	88	86	78	72	80	84				140	116	122	112	124	130	128				107	91
58	P	SKB	1506309			112	104	92	96	94	92	96				136	150	110	122	130	132	132				99	110
59	S	JPS	1515039			90	86	88	80	80	88	92				136	142	140	152	154	160	148				93	94
60	P	KN	1514212			72	86	82	80	76	76					154	140	132	146	122	118					98	88

S. No.	Randomization	Initials	MRD No.	MAP at 30 mins	MAP at 1 hr	MAP at 1.5 hr	MAP at 2 hr	MAP at 2.5 hr	MAP at 3 hr	MAP at 3.5 hr	MAP at 4 hr	Baseline DBP (mmHg)	DBP at 0 mins (initiation of block)	DBP at 30 mins	DBP at 1 hr	DBP at 1.5 hr	DBP at 2 hr	DBP at 2.5 hr	DBP at 3 hr	DBP at 3.5 hr	DBP at 4 hr	BaselineSpO2 (%)	SpO2 at 0 mins (initiation of block)	SpO2 at 30 mins	SpO2 at 1 hr	SpO2 at 1.5 hr	SpO2 at 2 hr
51	P	RMS	1496033	91	100	94	97					90	78	70	80	76	78					97	97	98	98	97	97
52	P	AA	1504140	76	73	83	82					70	62	62	60	70	68					96	97	96	96	97	98
53	S	BK	1479268	83	84	92						90	68	70	72	80						99	98	98	99	99	
54	P	RS	1504605	85	72	83	81					72	70	72	56	70	68					96	97	96	95	96	96
55	S	SS	314282	91	95	91	97					72	58	62	72	64	80					98	97	96	96	97	97
56	S	SR	1507767	75	85	76	81					70	62	60	72	62	68					97	98	98	97	98	98
57	P	RS	1506352	87	85	87	87	87				90	78	70	72	68	66	66				95	95	94	95	94	94
58	P	SKB	1506309	89	87	91	89	91				80	90	78	70	72	68	70				95	96	97	96	96	95
59	S	JPS	1515039	92	97	98	113	101				72	70	68	70	70	90	78				95	100	100	100	100	100
60	P	KN	1514212	84	102	90	85					70	62	60	80	74	68					98	98	97	99	98	98

S. No.	Randomization	Initials	MRD No.	SpO2 at 2.5 hr	SpO2 at 3 hr	SpO2 at 3.5 hr	SpO2 at 4 hr	Baseline RR (per minute)	RR at 0 mins (initiationo f block)	RR at 30 mins	RR at 1 hr	RR at 1.5 hr	RR at 2 hr	RR at 2.5 hr	RR at 3 hr	RR at 3.5 hr	RR at 4 hr	Baseline HR (bpm)	HR at 0 min (on arrival in PACU)	HR at 1st hr	HR at 2nd hr	HR at 3rd hr	HR at 4th hr	HR at 6th hr	HR at 8th hr
51	P	RMS	1496033					16	20	20	20	20	20					82	102	104	100	94	96	84	90
52	P	AA	1504140					20	22	20	20	18	20					82	86	80	80	72	78	80	80
53	S	BK	1479268					22	22	20	20	20						92	96	84	88	76	84	82	88
54	P	RS	1504605					18	20	20	20	18	18					92	102	106	108	100	92	98	88
55	S	SS	314282					22	20	18	18	18	18					84	78	68	66	76	80	92	94
56	S	SR	1507767					22	20	20	18	18	18					66	70	82	80	68	62	68	72
57	P	RS	1506352	95				20	20	18	22	18	18	20				82	102	98	92	88	86	86	84
58	P	SKB	1506309	95				22	24	22	20	22	20	18				112	102	100	98	96	102	86	88
59	S	JPS	1515039	100				20	22	22	20	20	20	20				90	96	88	104	100	96	98	90
60	P	KN	1514212					20	20	18	18	18	20					72	74	72	70	76	80	82	88

S. No.	Randomization	Initials	MRD No.	HR at 12th hr	HR at 16th hr	HR at 20th hr	HR at 24th hr	Baseline SBP (mmHg)	SBP at 0 min (on arrival in PACU)	SBP at 1st hr	SBP at 2nd hr	SBP at 3rd hr	SBP at 4th hr	SBP at 6th hr	SBP at 8th hr	SBP at 12th hr	SBP at 16th hr	SBP at 20th hr	SBP at 24th hr	BaselineDBP (mmHg)	DBP at 0 min (on arrival in PACU)	DBP at 1st hr	DBP at 2nd hr	DBP at 3rd hr	DBP at 4th hr
51	P	RMS	1496033	88	86	82	84	130	150	160	164	130	150	158	160	162	140	150	132	90	88	90	82	82	80
52	P	AA	1504140	80	98	98	102	130	160	150	156	152	160	148	116	146	140	180	160	70	80	70	72	80	92
53	S	BK	1479268	102	96	90	86	146	130	116	124	120	122	130	150	162	148	156	140	90	80	68	72	80	68
54	P	RS	1504605	98	104	90	92	116	120	122	124	124	120	104	108	110	126	118	102	72	70	68	70	94	92
55	S	SS	314282	90	118	102	104	126	140	142	120	134	148	160	150	146	150	160	170	72	90	80	70	72	90
56	S	SR	1507767	78	68	60	74	110	104	126	112	108	110	108	108	130	116	108	108	70	72	70	48	62	62
57	P	RS	1506352	96	80	92	88	140	152	166	160	154	154	170	158	160	164	140	130	90	96	98	86	84	86
58	P	SKB	1506309	84	92	94	110	136	138	126	130	140	142	132	110	120	140	110	150	80	70	60	70	80	90
59	S	JPS	1515039	86	78	78	86	136	140	142	150	112	120	136	120	112	140	136	146	72	80	76	90	70	68
60	P	KN	1514212	94	96	88	82	154	164	180	166	174	140	130	118	148	140	152	136	70	72	110	90	100	90

S. No.	Randomization	Initials	MRD No.	DBP at 6th hr	DBP at 8th hr	DBP at 12th hr	DBP at 16th hr	DBP at 20th hr	DBP at 24th hr	BaselineSpO2 (%)	SpO2 at 0 min (on arrival in PACU)	SpO2 at 1st hr	SpO2 at 2nd hr	SpO2 at 3rd hr	SpO2 at 4th hr	SpO2 at 6th hr	SpO2 at 8th hr	SpO2 at 12th hr	SpO2 at 16th hr	SpO2 at 20th hr	SpO2 at 24th hr	SL at 0 min (on arrival in PACU)	SL at 1st hr	SL at 2nd hr	SL at 3rd hr
51	P	RMS	1496033	80	80	84	84	80	78	97	98	98	97	98	99	98	99	99	98	97	97	T12	L3		
52	P	AA	1504140	82	68	68	60	70	82	96	94	96	96	97	94	98	96	96	96	97	95	L1	L4		
53	S	BK	1479268	82	88	86	78	90	82	99	98	98	99	96	98	97	98	97	98	99	99	T12	L3		
54	P	RS	1504605	68	74	86	86	70	56	96	98	98	98	99	98	98	99	100	98	98	99	L1	L4		
55	S	SS	314282	70	80	76	90	92	90	98	94	94	97	95	98	96	96	98	96	97	96	L2	L5		
56	S	SR	1507767	70	68	90	82	80	74	97	98	97	96	98	97	98	96	94	95	98	97	T12	L3		
57	P	RS	1506352	100	84	80	70	88	70	95	96	96	97	95	95	96	96	97	95	96	96	L5			
58	P	SKB	1506309	68	60	72	80	60	92	95	98	97	96	92	94	94	95	92	94	95	95	L3			
59	S	JPS	1515039	80	70	68	92	76	72	95	99	99	100	100	96	96	97	97	98	96	96	L1	L4		
60	P	KN	1514212	80	72	80	82	90	68	98	98	97	98	97	98	98	96	96	97	97	98	L1	L4		

S. No.	Randomization	Initials	MRD No.	SL at 4th hr	SL at 6th hr	SL at 8th hr	SL at 12th hr	SL at 16th hr	SL at 20th hr	SL at 24th hr	Pre-operative VAS score at rest	VAS score at 0 min (on arrival in PACU)	VAS score at 1st hr	VAS score at 2nd hr	VAS score at 3rd hr	VAS score at 4th hr	VAS score at 6th hr	VAS score at 8th hr	VAS score at 12th hr	VAS score at 16th hr	VAS score at 20th hr	VAS score at 24th hr	Quadriceps muscle strength at 24 hrs	Quadriceps muscle strength at 48 hrs	Weight-bearing at 24 hrs
51	P	RMS	1496033								10	0	0	0	0	0	0	0	0	2	0	0	2	4	2
52	P	AA	1504140								9	0	0	0	6	2	0	0	0	0	0	0	1	3	1
53	S	BK	1479268								9	0	0	0	0	0	0	2	0	2	2	0	1	4	1
54	P	RS	1504605								7	0	0	0	0	0	0	0	2	8	0	0	2	4	2
55	S	SS	314282								9	0	0	0	0	2	7	2	2	3	2	2	3	5	2
56	S	SR	1507767								10	0	0	0	0	0	3	3	1	0	2	2	1	3	2
57	P	RS	1506352								8	0	0	0	0	0	0	0	2	0	0	0	3	5	2
58	P	SKB	1506309								10	0	0	0	0	0	0	2	0	2	0	2	1	4	2
59	S	JPS	1515039								10	3	3	8	2	2	3	0	2	0	2	2	1	3	1
60	P	KN	1514212								9	0	0	3	2	2	0	0	0	0	0	0	2	4	1

S. No.	Randomization	Initials	MRD No.	Weight-bearing at 48 hrs	VAS score at 24 hours at rest	Time at which first rescue opioid analgesic needed	Total amount of opioid analgesic used in 24 hours period (Tramadol in mg)	Total amount of opioid analgesic used in 24 hours period (Fentanyl in mcg)	Total duration of analgesia of PENG/ SIFI (mins)	Overall patient satisfaction for pain management (within 24 hours)	Surgeon's satisfaction to anaesthesia services for overall pain management
51	P	RMS	1496033	4	0	17 hrs	50 mg	0	1020	very satisfied	very satisfied
52	P	AA	1504140	3	0	5 hrs	100mg	0	300	satisfied	satisfied
53	S	BK	1479268	5	0	10 hrs 45 mins	150mg	0	645	satisfied	satisfied
54	P	RS	1504605	4	0	18 hrs	100mg	0	1080	very satisfied	very satisfied
55	S	SS	314282	5	2	8 hrs 15 mins	100mg	0	495	satisfied	satisfied
56	S	SR	1507767	5	2	12 hrs 30 mins	150mg	0	750	satisfied	satisfied
57	P	RS	1506352	4	0	13 hrs 30 mins	100mg	0	810	satisfied	satisfied
58	P	SKB	1506309	4	2	17 hrs	100mg	0	1020	satisfied	satisfied
59	S	JPS	1515039	5	2	4 hrs 30 mins	150mg	0	270	dissatisfied	dissatisfied
60	P	KN	1514212	4	0	4 hrs 45 mins	100mg	0	285	satisfied	satisfied

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Subject:: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 25.09.2023 has approved the plan of thesis of **Tanusha Saini**, a student of your college for **MD Anaesthesiology** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Comparison of pericapsular nerve group (peng) block versus supra inguinal fascia iliaca (sifi) block for postoperative analgesia in hip surgeries .

Supervisor
Dr. M Rupinder Singh
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Co-Supervisor:-
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The student may submit the thesis in triplicate alongwith the plan in triplicate also, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

Controller of Examinations

Note :
1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*

COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

ANAESTHESIOLOGY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

AUGUST, 2022

DR TANUSHA SAINI

DEPARTMENT OF ANAESTHESIOLOGY
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ABSTRACT OF PLAN OF THESIS

Title	Comparison of Pericapsular Nerve Group (PENG) Block versus Supra Inguinal Fascia iliaca (SIFI) Block for postoperative analgesia in Hip surgeries
For the degree of	M.D. Anaesthesiology
Name of the candidate	Dr Tanusha Saini
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Co-Supervisor	Dr Udeyana Singh, Associate Professor, Department of Anaesthesia, DMCH Ludhiana Dr Rajnish Garg, Professor & Head, Department of Orthopedics, DMCH Ludhiana
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Hip procedures are common orthopedic surgeries which are performed very routinely these days. These are associated with significant amount of pain. Therefore, adequate analgesia is very crucial post-operatively to enhance dynamic pain relief, early patient recovery, reduced hospital stay, prevention of readmissions along with overall improved patient satisfaction to recovery. Peripheral nerve blocks can efficiently reduce this pain associated with these procedures enhancing overall patient outcomes.

Aims and objectives: The aim of this study is to compare the analgesic efficacy of ultrasound guided pericapsular nerve group (PENG) block versus supra-inguinal fascia iliaca (SIFI) block for postoperative pain relief in hip surgeries.

Materials & methods: A prospective, double-blinded randomised study will be conducted in 60 adult patients of ASA- I to III undergoing orthopaedic surgeries for hip fractures, hemiarthroplasty and THA under sub-arachnoid block in which they will be randomly allocated to either one group which will receive USG-guided PENG block or to another which will receive USG-guided SIFI block. Postoperative analgesic efficacy will be compared in both the groups by comparing VAS scores at rest at 24 hours and functional mobility at 24 and 48 hours postoperatively by assessing the quadriceps muscle strength.

Clinical Significance: Adequate postoperative analgesia is essential to restore painless hip joint especially in arthroplasty to provide early functional recovery and rehabilitation which aids to improve range of motion and strengthen the muscle power around hip joint. SIFI and PENG blocks provide good postoperative analgesia and early ambulation outcomes for these surgeries. This study will determine which block has superior effect in terms of overall improved outcome for the patient.

Keywords: Pericapsular nerve group (PENG) block, Supra-inguinal fascia iliaca (SIFI) block, Visual analog score (VAS), ultrasound-guided.

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CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES"** exist in the Department of Anaesthesia at Dayanand Medical College and Hospital, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis are genuine and is collected by the candidate herself under our supervision and guidance.

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PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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3.	COURSE OF STUDY AND SUBJECT	M. D. ANAESTHESIOLOGY
4.	DATE OF ADMISSION OF COURSE	7th MARCH, 2022
5.	TITLE OF THE TOPIC	Comparison of Pericapsular Nerve Group (PENG) Block versus Supra Inguinal Fascia iliaca (SIFI) Block for postoperative analgesia in Hip surgeries.

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Hip surgeries are one of the commonest procedures performed in the orthopaedic practice which include surgeries for hip fractures, degenerative diseases of the hip or total hip arthroplasty for osteoarthritis.[1] Pain remains the most common complaint both in the preoperative and the postoperative period.[2] Multimodal analgesia remains the method of choice for relief of pain in this group of patients. It includes peripheral nerve blocks, opioids and non-opioid medications which provide adequate analgesia [3], thereby facilitating early ambulation and thus reducing the incidence of deep vein thrombosis (DVT), faster rehabilitation and improved patient satisfaction.

Systemic analgesia is the most commonly used method for treating acute pain in the Post Anaesthesia Care Units (PACUs).[2] For this purpose, a combination of opioid analgesics, paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs) are widely used.[2] Opioids are effective analgesics but are associated with many side effects [2] most important of which is respiratory depression, addiction and potential for future risk of substance abuse [4]. They require more aggressive monitoring and careful titration especially in the elderly. Effective peri-operative analgesia that minimises the need for opioids and related adverse effects is essential especially in the elderly population.[1] Although epidural anaesthesia and lumbar plexus nerve block for hip surgeries are effective analgesics in the post-operative period, performing these neuraxial blocks is hesitated as they lead to prolonged motor block due to deep nerve block and hence prolong the hospital stay and delay discharge.

Peripheral nerve blocks have the advantage of potent analgesia, minimal systemic complications which are associated with central neuraxial blockades and less motor blockade, therefore leading to early patient recovery.[5] Motor sparing analgesia as a part of multimodal analgesic

protocol includes pericapsular nerve group (PENG) block, fascia iliaca compartment block, lumbar erector spinae plane block, trans-muscular quadratus lumborum block and periarticular infiltration of hip. [6]

The anterior capsule of the hip is innervated by the sensory articular branches of the femoral nerve, accessory obturator and obturator nerve.[2] The anterior capsule is the most richly innervated section of the joint, suggesting these nerves should be the main target for hip analgesia.[1] Pericapsular nerve group (PENG) block, blocks these nerves which innervates the anterior capsule of the hip and has been found to be very effective in controlling pain along with the advantage of motor sparing of quadriceps and other motor components of these nerves in patients with hip fracture surgeries.

Supra-inguinal fascia iliaca (SIFI) block which is a newer and improved approach to Fascia iliaca compartment block (FICB) has also been used and shown to reduce opioid consumption and pain scores following hip surgeries especially total hip arthroplasty.[4] It involves anterior access to the lumbar plexus via supra-inguinal approach superficial to the iliacus muscle blocking both the femoral and the lateral femoral cutaneous nerve (LFCN) completely. As they are not branched off and have a more consistent course at this location, it may lead to involvement of motor component as well and hence might be associated with quadriceps muscle weakness which might delay ambulation.[4]

Hence, the purpose of this study is to compare the postoperative analgesic effect of pericapsular nerve group (PENG) block versus supra-inguinal fascia iliaca (SIFI) block in hip surgeries in both the groups in terms of pain at 24 hours, functional mobility at 24 and 48-hours post-operatively, time to need for first rescue analgesia, total opioid consumption in first 24 hours along with overall patient satisfaction to recovery and surgeon’s satisfaction to overall pain management.

6.2 REVIEW OF LITERATURE

Hip fractures and arthroplastic surgeries of hip have been found to be associated with severe post-operative pain requiring large doses of opioids for pain relief in PACUs. Adequate postoperative analgesia is important for early ambulation and recovery of patient.[1,2] Multimodal analgesia strategy combines analgesics with different mechanisms of action to improve pain management.[3] Regional anaesthesia techniques are one of the methods of analgesia which plays an important role in reducing post-operative total opioid consumption, better dynamic pain relief, decreased hospital stay and cost expenditure along with overall improved patient satisfaction.[3]

Therefore, numerous regional anaesthesia techniques have been developed and been combined for adequate pain management in post - operative period. [6]

Calum R.K. Grant et al in April 2008 studied the role of regional anesthesia in providing analgesia for primary hip and knee arthroplasty. He considered combining different classes of analgesic drugs and techniques is important to facilitate early rehabilitation like epidural and spinal analgesia along with intrathecal opioids, single-shot or continuous peripheral nerve blocks like lumbar plexus block, femoral nerve block, fascia iliaca block, sciatic nerve block, etc. Regional anesthetic techniques have been shown to offer several advantages over general anesthesia for hip surgeries as they are associated with less intra- and post-operative blood loss due to reductions in mean arterial pressures and veno-dilatation.[6,7]

Various nerve blocks have been tried since then for this purpose and been compared to determine their efficacy both in terms of pain relief and early mobilization along with their benefit of minimal systemic complications and better acceptance especially in the elderly patients. Marina Temelkovska et al in 2014 compared Continuous Femoral nerve block (CFNB) with

Fascia iliaca Compartment block (FICB) in sixty patients as post operative analgesic method in hip fracture surgeries and found that pain relief was superior and prolonged in CFNB group versus FIC group both at rest and at movement. Also, patients in CFNB group received smaller amounts of additional analgesic agents and had fewer side effects compared to FICB patients.[2]

Another study done by S Petchara et al in 2015 on seventy elderly hip fracture patients with ASA III-IV evaluated postoperative outcome using Combined lumbar and sacral plexus block (CLSB) as a sole anesthetic method in hip fracture surgeries in high surgical risk geriatric patients and found that it has very good efficacy and safety profile in these patients without any serious complications. [8]

Motor sparing pain relief methods for hip surgeries became popular eventually which provide pain relief without blocking the motor component of the nerve, thereby facilitation early ambulation and reduced incidence of DVT and pulmonary embolism in the patients undergoing hip surgeries.

Laura Giron-Arango et al in November 2018 conducted a study in five patients in which they gave Pericapsular nerve group (PENG) block for analgesia in hip fractures and evaluated these patients for mobility. They reported significantly reduced pain scores compared with baseline along with improved functional mobility and no quadriceps weakness in these patients.[1] Similarly, G. Pascarella et al in July 2021 also conducted a study in sixty patients and found that PENG block following total hip replacement decreased pain scores and opioid consumption during the first 48 hours after surgery compared to the control group with no block.[8,9]

FICB was first described by Dalens and colleagues in 60 pediatric patients as a relatively safer and better alternative to the Femoral Nerve block as an anterior approach to the lumbar plexus where LA is injected proximally beneath the fascia iliaca blocking FN, LCN and ON.[10] N. O'Reilly et al also described fascia iliaca compartment block (FICB) technique as safe and simple means of providing analgesia for procedures involving hip joint

and femur with suprainguinal approach being more effective at achieving successful block of all three nerves.[11]

D Roriz et al in 2021 also conducted a similar study in eight patients in which they found that Pericapsular nerve group (PENG) block may be a safe and useful analgesic technique with a potential motor blocking-sparing effect and showed reduction in opioid consumption postoperatively, thus reducing the opioid related adverse effects.[12]

Ting Zheng et al published a study in 28 patients in which they found that supra-inguinal fascia iliaca block (S-FICB) which is a modified Fascia iliaca compartment block (FICB) provides an effective post-operative analgesic adjunct after THA with the satisfactory blockade of femoral, obturator and sciatic nerves when compared with the existing techniques for hip analgesia.[13]

A study was published by Irina Gasanova et al in which they compared ultrasound-guided Supra-inguinal fascia iliaca block (SIFI) versus periarticular infiltration (PAI) of hip in 60 patients for pain management after total hip arthroplasty but found no significant differences in the pain scores, time to ambulation and postoperative opioid requirements between the groups. Muscle weakness was found in the SIFI group at 6 hours post-operatively though.[14]

Ashok Jadon published a study in sixty six patients in August 2021 with others comparing SIFI block with PENG block for ease of positioning during spinal anesthesia and found that NRS pain scores decreased significantly in both the groups at rest and movement but the PENG block provided better pain relief and ease of positioning during SAB in patients with fractured hip scheduled for hip surgery.[15]

Faramarz Mosaffa et all in February 2022 published a study in which they found a significant reduction in VAS score in the PENG block group compared to FICB group after 15 minutes of block and 12 hours post-surgery. The time for need of first analgesic consumption was also significantly longer in the PENG group indicating that PENG block is

superior to FICB in providing hip fracture analgesia.[16] Similarly, K.S. Senthil et al from India published a similar study done on forty patients in March 2022 with findings suggestive of PENG block as more appropriate analgesic modality than FICB patients showing notable differences in VAS scores and motor power of quadriceps femoris indicating potency of sensory blockade and motor sparing in PENG block patients than FICB.[17] Yong Seon Choi et al in March 2022 published a study done on 58 patients comparing PENG block versus SIFI block for total hip arthroplasty under general anesthesia and found that pain scores at rest were lower in PENG group than those in the SIFI group postoperatively at 6 and 24 hours but there were no significant differences in pain scores between the groups throughout 48 hours period post-operatively. Quadriceps strength and opioid consumption were also similar in both the groups under general anaesthesia.[18,19]

However, studies for comparison in these groups under spinal anaesthesia are very less and the sample size taken also is very less which might not be relevant when applied to larger population. Therefore, this study will compare PENG versus SIFI block in terms of static and dynamic pain relief post-operatively in hip surgeries done primarily under spinal anaesthesia.

6.3 AIMS AND OBJECTIVES OF THE STUDY

The aim of this study is to compare

- the pain scores at 24 hours at rest
- functional mobility by assessing quadriceps muscle strength and maximum weight bearing possible at 24 hours and 48 hours post operatively
- time for first rescue analgesia
- total opioid consumption in first 24 hours
- overall patient satisfaction for pain management within 24 hours in both the groups
- surgeon's satisfaction to anaesthesia services for overall pain management post operatively

7. MATERIALS AND METHODS

7.1 SOURCE OF DATA

A randomized double-blinded observational study will be conducted in the Department of Anaesthesiology, Dayanand Medical College & Hospital, Ludhiana after approval from Institutional Ethics Committee on a total of 60 ASA- I, II, III adult patients undergoing hip surgeries for fractures, hemiarthroplasty and total hip arthroplasty under subarachnoid block who would be randomly allocated to 2 groups of 30 patients each by computer generated randomization codes contained in sealed, sequentially numbered envelopes. Informed consent will be obtained from all the patients.

7.2 METHOD OF COLLECTION OF DATA

INCLUSION CRITERIA

- Patients aged 40-85 years of age
- ASA Physical status I, II, III
- Electively scheduled for hip surgeries.
- Body mass index between 18-35 kg/m2

EXCLUSION CRITERIA

- Known allergy to study drugs
- Contraindication to neuraxial blockade or peripheral nerve blocks
- Chronic opioid use
- Diabetic neuropathy
- Infection at the site of block

GROUP ALLOCATION

After written informed consent, approximately sixty patients scheduled for undergoing hip surgeries which include surgeries for hip fractures (neck of femur, intertrochanteric and subtrochanteric fractures of femur), dynamic hip screw fixation, proximal femur nailing and hemiarthroplasty, total hip arthroplasty (THA) will be randomised into two groups of thirty each to receive either Pericapsular Nerve Group Block (PENG) block (Group

PENG) or Supra-Inguinal Fascia iliaca (SIFI) Block (Group SIFI) along with the sub-arachnoid block as the primary anaesthesia technique for the procedure.

The randomization scheme used will be prepared by our biostatistician through computer generated random numbers and those involved in the study would be unaware of the group allocation. The allocation envelope will be opened by an anaesthesiologist who would not be involved with the direct clinical care of the patient. They will then prepare the local anaesthetic solution as per the group allocation and perform these blocks accordingly under ultrasound guidance. A blinded observer will assess pre-operative and post-operative pain scores. This observer will also not be involved in the direct clinical care of the patient. The randomization codes would be decoded at the end of the study period.

PREANAESTHETIC CHECKUP

Pre operative routine anaesthesia check-up will be done one to two days prior to surgery for all the patients which will include a thorough history taking, general physical and systemic examination, relevant haematological and radiological investigations, thereby optimising the patient for surgery. Demographic information like age, sex, BMI, residence and type of hip surgery will also be recorded. Patients will be explained about the study being conducted and written informed consent will be taken along with education on use of VAS scale.

Preoperative VAS at rest will be noted prior to shifting the patient to the operating room (OR). The standardised premedication regimen if not contraindicated will be given to all the patients in the preoperative period consisting of tab pantoprazole 40 mg oral and tab alprazolam 0.25 mg oral on the morning of surgery with sips of water two hours prior to surgery.

ANAESTHESIA TECHNIQUE

On arrival in the OR, patients will be positioned supine on the operating table and routine continuous monitoring in the form of 5-lead ECG, heart rate, non-invasive BP cycled every 2 minutes, temperature and pulse

oximetry will be done. All the patients in both the groups will receive subarachnoid block with the total drug volume ranging from 2.8 to 3.2 ml consisting of fixed 0.5 ml of fentanyl (25 mcg) with varying volume of 0.5% hyperbaric Bupivacaine depending on patient height, weight, age, sex and duration of surgery using a 26-gauge Quincke's needle in sitting position under all sterile conditions. Immediately after sub-arachnoid block, after achieving the required level of blockade with patient in supine position, ultrasound-guided respective blocks will be administered in these patients according to the groups assigned to them.

BLOCK TECHNIQUE

Group PENG will receive pericapsular nerve group block performed under USG guidance. A curvilinear low frequency (2-5 MHz) ultrasound probe will be initially placed in a transverse plane over the Antero inferior iliac spine (AIIS) and then will be aligned with the pubic ramus by rotating the probe counter clockwise approximately 45 degrees. In this view, the ilio-pubic eminence, the iliopsoas muscle and tendon, the femoral artery, and pectineus muscle will be visualised. A 21-gauge, 100 mm stimuplex ultra 360 (B BRAUN) needle will be inserted from lateral to medial direction in an in-plane approach, to place the tip of the needle in the musculofascial plane between the psoas tendon anteriorly and the pubic ramus posteriorly.[20] 2 ml of local anaesthetic 2% lignocaine will be injected to confirm the tip location. Once the proper position is confirmed, following negative aspiration, 30ml of 0.2% Ropivacaine with 4mg dexamethasone will be injected slowly while observing for adequate fluid spread in this plane.

Group SIFI patients will receive supra-inguinal fascia iliaca block using ultrasound guided supra-inguinal approach with a high frequency (6-14Mhz) linear probe in the supine position. Initially, the anterior superior iliac spine (ASIS) will be palpated. The transducer will be placed in the inguinal crease to identify the femoral artery in the short axis. From the femoral artery, the transducer will be translated laterally to identify the

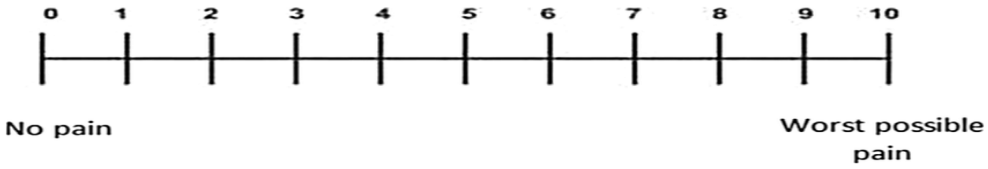
sartorius muscle. The sartorius will be traced cephalad to its insertion on the ASIS. Using this technique, the hypoechoic shadow of the ASIS will be easily identifiable just cephalad to the insertion of the sartorius. Medial to the shadow of ASIS, lies the iliacus muscle. With the ASIS and iliacus identified, the medial end of the transducer will be rotated to point at the umbilicus, which is the final transducer position. With the transducer in the final position, sonographic anatomy will be identified, from superficial to deep, consisting of subcutaneous fat, the internal oblique muscle, the transverse abdominus muscle, the fascia iliaca overlying the iliacus muscle, and the iliacus muscle itself. A 21-gauge, 100-mm stimuplex (ultra360) B. Braun block needle will be advanced in-plane fashion from caudal to cephalad end to puncture the fascia iliaca. With the needle tip just below the fascia iliaca, 2 mL of a local anaesthetic will be injected to confirm the tip location.[10,11] Once the proper position is confirmed, 30 mL of 0.2% Ropivacaine with 4mg dexamethasone will be incrementally injected superficial to the iliacus muscle and deep to the fascia iliaca. After completion of the injection, the transducer will be translated medially toward the femoral nerve, where caudomedial spreading of the local anaesthetic will be easily identified.

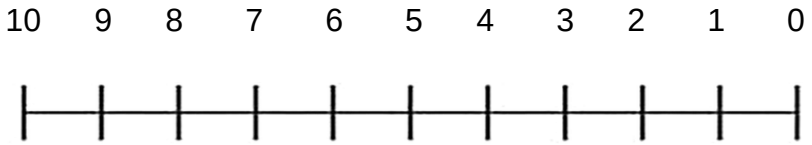
Hip surgeries will be performed in these patients and intra-op recording of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), respiratory rate (RR), oxygen saturation (SpO2) along with recording of sensory level of blockade will be done at the time of initiation of block and then every 30 minutes compared to the baseline vitals of the patient. After completion of the procedure, the patients will be shifted to post anaesthesia care unit (PACU) where post-operative vitals (HR, SBP, DBP, SpO2) along with VAS score at rest and sensory level of blockade will be monitored hourly for the first 4 hours, 2 hourly for the next 4 hours and then every 4 hourly till 24 hours post-operatively. A standardised analgesic regimen if not contraindicated

comprising injection paracetamol 1 gram 8 hourly will be given to all the patients.

FOLLOWING OUTCOMES WILL BE MEASURED POST OPERATIVELY to evaluate the analgesic efficacy of the blocks both in terms of static pain relief that is pain at rest and dynamic pain relief that is degree of functional mobility possible.

- PRIMARY OUTCOME: Postoperative pain will be measured using VAS pain scores at 24 hours at rest in both the groups where the score will be determined by asking the patient to rate the pain from 0-10 where a VAS score of 0 will indicate 'no pain' to VAS score of 10 indicating 'worst pain'. [21]





- SECONDARY OUTCOME:

1. Functional mobility will be assessed by:
   (a) QUADRICEPS MUSCLE STRENGTH: the most commonly accepted method for evaluating the muscle strength i.e. The Oxford Scale Aka Medical Research Council Manual Muscle Testing (MMT) scale will be used where quadriceps muscle strength will be assessed at 24 and 48 hours against the resistance and gravity, hence grading the patient's strength on a 0 to 5 scale accordingly [22]

   Grade 0- complete inability to contract the muscle

Grade 1- only a slight contraction or flicker of muscle

Grade 2- moving leg through its complete range of motion, but only in a horizontal plane, not against the pull of gravity

Grade 3- able to hold leg up off the table against the pull of gravity, but not able to withstand any additional pressure

Grade 4- able to hold up leg actively against gravity and some resistance

Grade 5- actively holding up leg against gravity and strong resistance

b) WEIGHT-BEARING: After surgery of the hip, it is of utmost importance for recovery to get the right amount of weight-bearing when moving around using crutches or walkers. This will be assessed by following grades-

At 24 hours using non-weight bearing (NWB) as Grade 1 where the leg must not touch the floor and is not permitted to support any weight at all or toe-touch weight-bearing (TTWB) as Grade 2 where the foot or toe may touch the floor (such as to maintain balance) but is not permitted to support any weight whichever maximum the patient is able to perform.

And at 48 hours by assessing the maximum weight bearing the patient can perform- partial, tolerated or full where:

Partial weight-bearing (PWB) or Grade 3 is a small amount of weight up to 50% which might be supported by the affected leg, which would permit the affected person to stand with his body weight evenly supported by both feet (but not to walk). Weight-bearing as tolerated (WBAT) or Grade 4 where the person independently chooses the weight supported by the extremity. Full weight-bearing (FWB) or Grade 5 where the leg can now carry 100% of the body weight, which permits normal walking.[23]

2. The time to need for first rescue opioid analgesia will be compared in both the groups.

   Injection tramadol 50-100 mg iv will be used as rescue analgesic whenever VAS $\geq$ 4 to a maximum of 400 mg within 24 hours [24] following which if VAS is still >4 then another rescue analgesic, injection fentanyl 1mcg/Kg iv as a slow bolus shall be administered to the patient.
3. The total opioid requirement in first 24 hours will be compared for both the groups.
4. Overall patient satisfaction for pain management within 24 hours in both the groups through a 5-point Likert scale.
5. Surgeon's satisfaction to anaesthesia services for overall pain management post operatively through a 5-point Likert scale.

STATISTICAL ANALYSIS

Data will be described in terms of range; mean ± standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. To determine whether the data is normally distributed, a Kolmogorov-Smirnov test will be used. Comparison of quantitative variables between the study groups will be done using Student t-test and Mann Whitney U test for independent samples for parametric and non-parametric data respectively. For comparing categorical data, Chi square ($\chi 2$) test will be performed and fisher exact test was used when the expected frequency is less than 5. A probability value (p value less than 0.05 will be considered statistically significant. All statistical calculations will be done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

SAMPLE SIZE CALCULATION

It is assumed that the prevalence rate of hip surgeries in our hospital is 4.2% based on the previous data.

Assumptions:

Mean Group (m1) = 2.10

Mean Group (m2) = 1.30

Coefficient of variation = 150%

Standard deviation Group (σ1) = 0.78

Standard deviation (σ2) = 0.57

The formula used is as under:

$n = (\sigma 12 + \sigma 22) (Z\alpha + Z\beta)^2 / (m1 – m2)^2$

Where,

Zα = Value of standard normal variate corresponding to α level of significance (1.96)

Zβ = The standard normal deviate for desired power (2.34)

m = Average

σ = Standard deviation

With the above assumptions the sample size for 95% confidence level & 99% power works out 27 in each group. This number has been increased to 30 per group (a total of 60 patients) to allow for a predicted dropout from the study.

7.**3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.**

No

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Applied for

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PROFORMA

Initials with MRD No.	
S. No.	
Age/Gender	
Height/ weight/ BMI	
Residence	

Randomization code:

Enrollment date:

Type of Hip surgery:

ASA grade:

Co-morbidities:

Time of Subarachnoid Block:

Level of sensory blockade achieved:

Level of motor blockade (Modified Bromage Scale):

Time of institution of PENG/SIFI block:

Duration of surgery in minutes (time from skin incision to closure):

VAS pain score:

Before Surgery	
Immediately after Surgery	
At 24 hours	

Signature of Candidate **Signature of Supervisor**

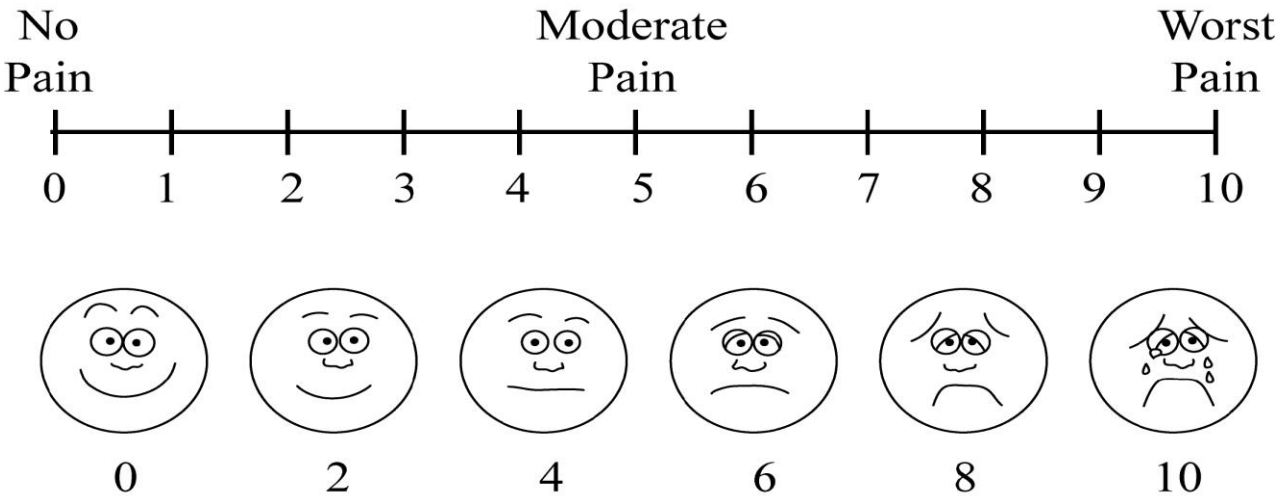
INTRA-OPERATIVE VITALS:

Time	sensory level	Heart Rate (bpm)	SBP (mmHg)	Mean Arterial Pressure (mmHg)	DBP (mmHg)	SpO2 (%)	Respiratory Rate (per minute)
Baseline							
0 min (initiation of block)							
30 mins							
1 hr							
1.5 hr							
2 hr							
2.5 hr							
3 hr							
3.5 hr							
4 hr							

Signature of Candidate **Signature of Supervisor**

POST OPERATIVE VITALS

Time since PENG/ SIFI block given	Time	Heart rate (bpm)	SBP (mm Hg)	DBP (mm Hg)	Oxygen Saturation (%)	Sensory level of blockade	VAS Score at rest
Baseline (pre-operative)							
0 min (on arrival in PACU)							
1 hr							
2 hr							
3 hr							
4 hr							
6 hr							
8 hr							
12 hr							
16 hr							
20 hr							
24 hr							



Signature of Candidate **Signature of Supervisor**

FUNCTIONAL MOBILITY AT 24 AND 48 HOURS:

		Grade with VAS
1. Quadriceps muscle strength (Grade 0-5)	At 24 hours At 48 hours	
2. Weight-bearing (Grade 1-5)	At 24 hours At 48 hours	

- VAS score at 24 hours at rest:
- Time at which first rescue opioid analgesic needed:
- Total amount of opioid analgesic used in 24 hours period (in mg and mcg):
- Total Duration of analgesia of PENG/SIFI Block (in minutes):

Overall patient satisfaction for pain management (within 24 hrs):

☐ Very satisfied ☐ satisfied ☐ neither satisfied nor dissatisfied ☐ dissatisfied ☐ very dissatisfied

Surgeon's satisfaction to anaesthesia services for overall pain management:

☐ Very satisfied ☐ satisfied ☐ neither satisfied nor dissatisfied ☐ dissatisfied ☐ very dissatisfied

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I…….D/o, W/o, S/o……..…… am willing to participate in the study **"COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

……. ……
Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य "**COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES**" में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

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गवाह के हस्ताक्षर	रोगी के हस्ताक्षर/अंगूठे का निशान
नाम:	नाम:

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अन्वेषक के हस्ताक्षर

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विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

“COMPARISON OF PERICAPSULAR NERVE GROUP (PENG) BLOCK VERSUS SUPRA INGUINAL FASCIA ILIACA (SIFI) BLOCK FOR POSTOPERATIVE ANALGESIA IN HIP SURGERIES” ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

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ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

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ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

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ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ